Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVI. No. 21. NEW YORK, WEDNESDAY, MAY 23, 1900. ISSUED WEEKLY.

Electrical Review

TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2339. NEW YORK.

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REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - - NEW YORK.

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Subscription to the ELECTRICAL REVIEW.

One Year, United States and Canada, $3.00
One Year, Foreign Countries, - 5.00
Single Copies, each - - - - - - - .10
Copies can be supplied for only one year back, at 25 cents each.

CONTENTS: PAGE

The Electric Light Convention ... 523
The Institute Meeting ... 524
The National Electric Light Association's Convention ... 525
Alternating-Current Generators ... 529
Series Enclosed Alternating Arc Lighting for Street Lighting Service ... 532
Exhibits and Exhibitors at the Chicago Convention of the National Electric Light Association ... 534
American Institute of Electrical Engineers ... 539
Telephony over Cables and Long-Distance Air-Lines ... 541
Automobile Show at Nuremberg ... 544
Electric Lighting ... 545
Dr. Henry S. Pritchett ... 545
Views, News and Interviews ... 545
The Independent Telephone Association ... 546
International Association of Municipal Electricians ... 546
Telephone and Telegraph ... 546
A Complete Series Alternating Enclosed Arc System ... 547
Paris Exposition Notes ... 547
Science Brevities ... 548
Marine Electric Light and Power ... 548
Electrically-Heated Soldering Irons ... 548
Standard Types of Ceiling and Desk Fans ... 549
A Wiring Tube Novelty ... 549
A Coal Mine Trolley Road ... 549
Electric Railways ... 549
Automobiles ... 550
Electrical Catalogues Wanted in Cuba ... 550
A Novel Electric Light Reflector ... 550
Personal ... 550
Compensators for Alternating-Current Circuits ... 550
Industrial Notes ... 552
Corporation News ... 554
A New Telephone Receiver ... 554
An Electrical Planked Shad Dinner ... 554
Wall Street and the Electrical Stock Market ... 555
Electromobile Construction in Germany ... 555
James Blake Cahoon, President, National Electric Light Association ... 555
Items of Interest ... 555
Attendants at the National Electric Light Association's Convention ... 556
Electrical Patents ... 51

Advertisers' Index, page 28.

THE ELECTRIC LIGHT CONVENTION.

The twenty-third convention of the National Electric Light Association has just passed into history and added itself to the former agreeable memories of such occasions which are cherished by the majority of the electrical profession in this country. The Chicago meeting this year was an unqualified success in all respects, the papers being unusually interesting and practical. A large attendance marked all the sessions and sustained interest was manifest on all sides.

Perhaps the most impressive feature of the personnel of the convention was the prominent position taken in it by the practical, young, enthusiastic engineers, belonging to what may be called the newer type of the profession. To these younger men the conventions are less a social occasion than an opportunity for instruction and mutual benefit. They come early to the meetings and stay late. They take intelligent and active part in the discussions and they go home filled with satisfaction and benefit from their attendance. This young blood in the association is a mark of long life. It is one of the reasons for the perennial activity of this most important and representative body of the electrical profession.

Certainly the most striking feature of the proceedings was the prominent part taken by the arc lamp. Both the report of the committee on the photometry of arc lamps and Professor Robb's paper on "Alternating-Current Enclosed Arc Lamps," brought out long and deeply interesting discussions which are quoted elsewhere. It seems as if the alternating-current enclosed arc lamp had solved, in some measure, the problem of feeding street arc lights from large direct-coupled units and had taken a long step toward the relegation of the present belt-driven arc machine to the museum of electrical antiquities. This opinion seems general in the association and the discussion turned upon methods of using the new lamp and new systems rather than whether or not they should be used.

A good deed was done when the report of the Committee on Standardization was adopted. This action puts the two most important and powerful representative bodies of the electrical field in absolute accord upon this important matter. In adopting the standards of the American Institute of Electrical Engineers as its own the National Electric Light Association has almost certainly made sure the universal adoption of this system. While it may be defective in spots it has the enormous merit of being a system, as opposed to the heterogeneous classification now in universal use.

The question of rates and accounting, which represent the business end of electric lighting, came in not only for admirable and thoughtful papers but for an extended and intelligent discussion as well. All the papers were good and the convention was unquestionably productive of much benefit to its attendants.

There were fewer exhibits than usual, but those that were shown were of considerable excellence as may well be judged from the descriptions of them in succeeding pages.

The third installment of Mr. Maynard's series of articles on "The Electrical Collections in the National Museum," in the last number of the ELECTRICAL REVIEW, is chiefly remarkable for the excellent collection of portraits of Professor Samuel F. B. Morse, some of which were there presented for the first time. The two portraits, one showing him at the age of twenty-three years, from a painting on ivory by himself, and the other at the age of forty-six years, from a daguerreotype, are of especial historical value. The illustration showing Morse's original transmitting and receiving telegraph are also exceptionally interesting.

THE INSTITUTE MEETING.

The meeting of the American Institute of Electrical Engineers, at Philadelphia, last week, was not only a very enjoyable occasion, but also one that will be remembered for the interest and value of the papers presented at it. Easily first of these is the brilliant solution, by Dr. M. I. Pupin, of one of the most obdurate problems in telephone and cable engineering.

The profound researches and speculations of Oliver Heaviside are only just becoming familiar to the great body of electrical engineers. In Heaviside's memoirs, couched in language unintelligible save to the elect few, is crystallized practically the whole of the theory of electrical wave transmission and in it were foreshadowed the fundamental facts which form the ground of the astonishing investigations, both experimental and mathematical, resulting in the paper above referred to. It has been known for some time that the effect of distributed capacity in a telephone circuit could be counteracted by inductance, but the latter must be similarly distributed. The problem has been to construct a circuit in which this distribution is made. For wave transmission purposes circuits in which the inductance is gathered at one or two points are useless. The natural experiment would be to divide it into a number of parts, and to try to discover when the subdivision is sufficiently similar to continuous distribution to accomplish the same object. This Professor Pupin has done in the brilliant series of mathematical papers leading up to and culminating in the last. The experimental confirmation has been so close to the calculated results that little doubt can be entertained of the correctness of the theory propounded. If this is admitted, the results to be expected from the application of the laws deduced are of vast commercial importance. Long-distance land lines will be able to vie with the telegraph network in extent, while ocean cable telephony will be at least possible. It is, of course, very doubtful if it will be useful, unless it can be duplexed with the telegraph, on account of the short overlap of business days in neighborhoods five hours of longitude apart. A phase of the application that was only briefly spoken of in the discussion, however, may be of the largest importance, and that is the use of such an artificial distortionless circuit on ocean cables for machine signaling.

The paper by Messrs. Crehore and Squier was most interesting, and should stand among Institute papers as a model for method of presentation. It was complete, well illustrated, the points made by its authors brought out so that none present had difficulty in understanding and appreciating them and upon the whole was a thoroughly satisfactory piece of work. The method suggested by its authors is one that seems to have everything to commend it and nothing to prevent its immediate adoption. One point which appears to be of extreme value was scarcely touched upon by the authors, and this is the compactness, the simplicity and the beautiful flexibility and regulation secured by the substitution of a dynamo machine for batteries at the cable termini.

The other papers were all good, that by Dr. Samuel Sheldon being particularly interesting. Two that were announced on the programme were not presented, that by Captain John Millis not being ready, and that by Mr. Hering being held over until next Fall, at the author's request, on account of the length of the sessions and the general desire for an adjournment.

All of the entertainments provided by the Philadelphia local committee, under the capable chairmanship of Mr. Charles A. Bragg, were exceedingly pleasant and were greatly enjoyed by all who had the good fortune to attend them.

There are very few times when it is proper and dignified for one to boast. Still, the music of any man's own trumpet might often be silent unless he blew it once in a while himself. It is with a view to all this that the ELECTRICAL REVIEW, looking back to its last number, pats itself upon the back and calls the attention of its readers to the good things that were served up to them in it. There was a history of the National Electric Light Association, and the biographies and portraits of all its presidents. There was an elaborate and complete article describing a fine electric lighting central station. There was an exclusive account of the business meeting and the first day's proceedings of the general meeting of the Institute of Electrical Engineers. There was also a highly interesting article by Mr. George C. Maynard on the telegraphic exhibits at the National Museum at Washington, in which were published for the first time two portraits of S. F. B. Morse. One of these is of extreme interest, since it was painted by Morse himself when he was quite a young man. There was an excellent article on the Pan-American Exposition, and one by Mr. A. D. Adams on incandescent street lighting. The news of the electrical industry was presented fully. We trust that our readers will pardon this fantasia upon our own trumpet, but how can we help it?

There has been some discussion as to what kind of building is best adapted for an automobile stable. Of course, it is comparatively easy to design and build a new building that will be sufficient for these vehicles, but the question is, what is the best type of existing building to adapt for the purpose? Could anything be better than a high-class storage warehouse, such as is found in most of our cities? Such buildings are provided with a large and powerful elevator sufficient to lift automobiles to any floor. Their floors are made capable of sustaining heavy weights. They are practically fireproof. They generally have their own electric lighting plant which could easily be made a charging plant as well. Naturally, the inclusion of electric vehicles would not interfere with their other work, though it is to be doubted if the insurance companies would relish the presence of machines loaded with gasoline in such a situation.

It may be noted that this issue of the ELECTRICAL REVIEW will be a day or two late in reaching subscribers and that in it are described events taking place after its date of publication. It has been decided in order to give the news of the National Electric Light Association's meeting at Chicago, to hold back this issue for several days. It was thought that our readers would be better pleased to wait some days and have this important news fresh than to wait over a week and receive it in the next regular number.

The National Electric Light Association's Convention,

Chicago, May 22, 23 and 24, 1900.

The twenty-third convention of the National Electric Light Association was called to order by President Samuel T. Carnes in the banquet hall of the Auditorium Hotel, Chicago, at 11 o'clock, Tuesday forenoon, May 22. There was an excellent attendance, representing all sections of the United States, from Seattle to the Atlantic seaboard, and from Canada to Buenos Ayres, South America. While a number of the familiar faces of the early days of the association were to be seen, there was a noticeable majority of the younger men, whose countenances were unknown to many of the old attendants. Among the pioneers of the association were to be seen E. R. Weeks, of Kansas City; Charles R. Huntley, of Buffalo; Frederic Nicholls, of Toronto, Canada; Samuel Insull, of Chicago, and E. H. Davis, of Williamsport, Pa.

During the temporary absence of Secretary George F. Porter, Mr. E. H. Davis was elected secretary *pro tem.* In calling the convention to order, President Carnes said:

In opening the session of the twenty-third convention, I congratulate you upon meeting again for the fourth time in the great city of Chicago; for aside from the natural advantages of these regular meetings for the discussion of the various practical questions that most deeply interest us and for the further advantage of absorbing the ideas and practices of the most advanced and scientific workers in this most wonderful branch of modern science, we have here in this great city these most advanced workings and up-to-date practices practically illustrated in a manner most satisfactory to the enquiring mind of the average central-station manager—who, in the majority of cases, perhaps, holds his position not for his original knowledge of the science, but for his ability to utilize this knowledge for the benefit of his stockholders, whose investments are made solely with a view to the returns.

I am sensible of the contrast between this session and your previous ones, and especially the twenty-first and twenty-second, just preceding, when we were presided over by gentlemen of marked ability and scientific attainments, whose opinions carried all that weight and value to which their own eminent success entitled them; while your present presiding officer represents that class of smaller central-station managers, who, while something of a veteran in the business management, is yet a neophyte in the science.

I appreciate to the fullest the compliment of being placed at the head of this organization, notwithstanding I accepted it as one to my section of the country, the South, and not to myself, individually.

Your indiscreet indulgence of this compliment at the expense of your better judgment constrains me to confess that I became sufficiently inoculated with that same unaccountable nerve to entertain seriously the idea of making an effort to deprive you of the advantages of meeting in Chicago, by calling this session in my own native city of Memphis, with naught to recommend it but its natural Southern hospitality; warm as its Summer sun, genuine as its native corn juice and as refreshing as its world-renowned mint; the combination of which has the happy tendency to produce an absolutely irresistible power-factor in the establishment of fraternal affection and brotherly love. A more mature reflection, however, convinced me that I would have to deprive myself of the pleasure of showing you the livest city in the South by consulting your better interests and coming to Chicago as originally intended. In this I am sure we have lost nothing, for I find that the wide-awake, up-to-date, progressive, whole-souled, all-around good fellows of the electrical fraternity here, have, with their usual enterprise and accustomed hospitality, made every provision for our entertainment and pleasure; and when the programme is announced I predict that the power factor of good-fellowship will be so fully established with the same high efficiency which has always characterized this famous city, that we will be unanimous in offering the least possible resistance.

Believing that the papers, which have been prepared by several gentlemen in response to urgent request, will cover subjects of the utmost interest to the greatest numbers present, at this time I refrain from offering any further recommendation than a careful consideration and a free discussion of them. I now declare this convention to be formally opened.

The secretary then read letters of regret from the following gentlemen:

Elihu Thomson, Lynn, Mass.; Nikola Tesla, New York; Professor Edward L. Nichols, Ithaca, N. Y.; Professor Henry T. Bovey, Montreal, Canada; Major R. E. Crompton, London, England, and E. F. Peck, Brooklyn, N. Y.

An invitation from President Insull, of the Chicago Edison Company, was read, giving the delegates the privilege of the station buildings of his company.

The report on the photometric value of arc lamps was then read by Mr. Henry L. Doherty, of St. Paul, Minn. Measurements were made in a somewhat unusual manner, securing great accuracy. Great care was taken to make all the tests under similar conditions and many interesting results were obtained, showing the distribution of light, the absorption of globes and the comparative value of shades, especially in the case of alternating-current enclosed arc lamps.

Mr. J. B. Cahoon, of Syracuse, N. Y., said, in opening the discussion, that the report was so interesting and valuable that he could not refrain from moving a vote of thanks to the committee which prepared it. This was carried.

Professor C. P. Matthews, of Purdue University, said that much credit was due the students who had assisted him in the investigation.

Mr. Samuel Scovil, of Cleveland, spoke of the importance of giving the committee more money to continue its work.

Mr. Doherty said that the work was one which could only be taken up as it had been by Professors Matthews and Goldsborough, as a labor of love. The central station is in business to sell light, not electricity, yet the association would certainly be willing to spend large sums if it saw a chance to increase machine efficiency 30 per cent. "If we bring up the efficiency of lamps and translating apparatus we have done virtually this, since we sell light, not current. We need funds and have been expecting to obtain sufficient by voluntary subscription. Any offer of financial assistance would be welcome; it is embarrassing to plead for it."

Mr. W. W. Bean, St. Joseph, Mich., moved the reference of the matter to the executive session, which was done.

Mr. Herbert A. Wagner, St. Louis, Mo., said that there is great need of standardization of arc lamps. The old ratings of 1,200 and 2,000 candle-power, while they meant nothing, were definitely understood to represent certain watt-ratings of lamps. On enclosed arc lamps there seems to be no standard whatever. Since the alternating arc is less efficient than the direct-current arc, manufacturers ought to make them of higher watt-consumption so as to give the same light. "It is possible even, if we take care, to make the alternating arc more efficient than the other."

Professor Matthews agreed with Mr. Wagner. He spoke of the power factor of the alternating arc which required more current to be put through it for the same light, since the current was out of phase with the electromotive force.

Mr. Hillman said some manufacturers had produced and practically standardized high-current street alternating lamps. He spoke of the experience in Atlanta, Ga., where 7.5-ampere alternating lamps were put in competition with 9.6-ampere open arcs and perfectly satisfied the city authorities. Visiting committees from other cities also were pleased with the alternating lamps. More than 5,000 of these large-current lamps are in daily use now.

Mr. Gilchrist, of Chicago, thought the standard lamp ought to be one requiring less current, not more. It is easier to place 450-watt lamps in Chicago, than higher wattage and more expensive lamps. He had even insisted on manufacturers producing 350-watt lamps. Chicago needed small lamps. One consumer who uses 250 arcs there has three-ampere lamps only.

Professor W. L. Robb, of Hartford, Ct., asked about the comparative value of alternating and direct lamps in the zones from horizontal to ten degrees below horizontal—in other words, their effectiveness for street lighting.

Professor Matthews said the data had not been worked up that way, but the suggestion was a good one. He spoke of the difficulty of making measures of illumination in the street. Mr. Wagner emphasized Professor Robb's remarks. He thought that there was a demand for low-wattage lamps but the present discussion

concerned illumination and not lamp powers. For the customer wishing interior lighting we have various sizes of lamps at various prices. For street lighting it is another proposition. He spoke at some length of conditions in St. Louis and of the satisfactory experience he had had with alternating lamps. Professor W. E. Goldsborough said that alternating arc lamps provided with shades showed an efficiency of 1.60 watts per candle against 1.65 for direct-current arc lamps; therefore, if all alternating lamps were provided with shades they would certainly show up as well in practice as the direct-current lamp.

In reply to questions Professor Matthews said that considering it by itself, without any mechanism, the direct is more efficient than the alternating arc. The reason of this, he said, is because the positive crater remains positive in the direct-current lamp and attains a very high temperature. It is alternately positive and negative in the alternating lamp. The alternating lamp is also dependent on the shape and intensity of the current wave. The power factor of the arc has also an important effect upon the light.

Mr. H. H. Wait, of Chicago, discussed at length the subject of street illumination. "If the association exerts its influence toward adopting minimum illumination of a street as a standard, then it will play into the hands of the Welsbach people." He thought the mean illumination was the more important consideration.

Mr. White, of Cincinnati, said that a discussion which has six elements could easily become confusing—alternating and direct lamps, indoor and outdoor lighting, multiple and series connection, and all their combinations. In street lighting there is a wide difference of conditions. On a Chicago boulevard there may be lines of arc lamps 50 feet apart on each side; in a residence district in a country town the lamps are 200 yards apart. Mr. White discussed the whole question of street illumination at considerable length and very interestingly. Upon the conclusion of his remarks the meeting adjourned until 2.30 P. M.

The session reconvened at 2.45 P. M., President Carnes in the chair, and papers by Messrs. F. A. Copeland, of La Crosse, Wis., and Harry J. Frith, of Watseka, Ill., on the subject of "Exhaust Steam Heating," were read and discussed at some length.

Mr. W. L. Abbott, of Chicago, then read his paper entitled "Operating Economies in Central Station Practice."

Mr. Abbott's paper was one of the intensely practical and sensible papers which electric light conventions generally produce. He spoke of methods for saving and renovating waste and oil at the Chicago Edison station and showed that an allowance of only three-quarters of a pound of new waste per shift was necessary to keep a 1,200 horse-power engine clean. From every 100 pounds of oily waste this company extracts 40 pounds of clean waste and 40 pounds of oil. He spoke of engine lubrication and the quality of oils. "One important saving," said Mr. Abbott, "can be made by paying the operatives partially in hopes and promises. By this I mean to have a well-defined and well-known line of promotion and to have each one know his position in that line and that his chances for promotion depend upon ability, fidelity and the length of time in service. The most demoralizing and disorganizing practice that can be introduced is to put a new man, a relative of an official or a friend of some politician, into a desirable position, over the heads of equally good men who have borne the drudgery and hard work of inferior positions."

Mr. Abbott called attention to the fact that a fireman whose wages are about 20 cents an hour will handle during an hour fuel costing from 10 to 15 times as much as his wages. It is easily possible, by watching and instructing the firemen to save double their wages in coal. In concluding Mr. Abbott said some of these economies may appear trivial, but a hundred dollars saved is that much added to the surplus and is as good as five hundred dollars increase in gross earnings. To add five hundred dollars monthly to the gross earnings requires an investment say of twenty-five thousand dollars. When these facts are considered we may realize what a valuable asset is an engineer prolific in methods for keeping down costs.

In reply to questions by Mr. Scovil, of Cleveland, Mr. Abbott said that automatic stokers generally show better results than hand firing. Professor Goldsborough emphasized, from the point of view of an instructor familiar with young men and their attitude, the point made by Mr. Abbott in regard to encouraging employees by prospect of advancement. Regarding the point of adjusting boilers to the work that is required of them, Professor Goldsborough said that he knew of cases where many thousand dollars could be saved every year by giving attention to this one simple matter.

Mr. H. L. Doherty spoke of making a regular analysis of flue gases. Central station managers, he said, took up the losses in their business in the order of their apparent importance rather than in the order of their actual importance. The amount of saving engineers can make on engines is small compared to that which can be made on boilers. Mr. Doherty spoke at length regarding the relative values of various classes of coal. Professor D. C. Jackson said Mr. Abbott's paper struck at the most important points in which small stations could interest themselves. Professor Jackson spoke at considerable length about fuel economy. Mr. E. A. Bement described a machine known as the econometer, which is used to determine the proportion of carbonic dioxide in flue gases. The machine is nothing but a suspended hollow glass ball, hung on a laboratory balance in a case which may be filled with the flue gas. The varying densities of the gas cause the apparent weight of the glass ball to vary, and hence give indications of its composition. The discussion at this point became general, Messrs. Cahoon, Doherty, Bement and others taking part. Upon motion of Mr. Doherty a committee was ordered appointed to determine the best method of analyzing flue gases.

Professor W. L. Robb then read the report of the Committee on Standardization of Electrical Apparatus. The report is as follows:

At the preceding convention of the association, held in New York, May, 1899, Mr. Paul Spencer, of Newark, N. J., chairman of the Committee on Standard Specifications for Electrical Apparatus, presented a report. This report approved of the work then being carried on by a committee of the American Institute of Electrical Engineers, in standardizing apparatus, and recommended that it should be the basis of any similar action on the part of this association so far as technical matters are concerned. Since that time a final report has been accepted and published by the Institute, the classification and rating of the various kinds of electrical apparatus being defined in considerable detail. This report was very well received and has already been formally approved by most of our prominent manufacturing companies and engineers. Although only published a few months, its recommendations are now commonly recognized and followed. It is generally conceded, even by its critics, that the report is impartial as well as substantially correct and that its general adoption will be a great benefit to the many interests affected by it.

Your committee believes that the approval of that report by the National Electric Light Association would be a powerful influence in securing its universal acceptance and recommends that such action be taken.

The same committee of the Institute is now working in cooperation with a Committee of the American Society of Mechanical Engineers to secure a standardization of the sizes, speeds and armature bore of direct-connected engines and dynamos, thus avoiding the confusion which now exists regarding these matters. Considerable progress has already been made and it is hoped that these committees will be able to secure the much desired uniformity. This is in line with the report already made and will probably commend itself to the association as being worthy of approval.

Regarding the advisability of preparing standard specifications, a matter that has been discussed before the association several times, there are differences of opinion, and

it is well to have the technical questions settled before taking up the commercial ones, but it would appear that the former will be formulated and accepted in the near future, so that the time would be ripe for at least considering the latter. It is wise to go rather slowly in these directions, but it is satisfactory to know that steady advance is being made.

Signed: F. B. Crocker, W. L. Robb, Calvin W. Rice.

Upon motion of Mr. Cahoon the specifications and standards of the American Institute of Electrical Engineers were approved and adopted by the association. The meeting then adjourned until Wednesday morning.

THE SECOND DAY—WEDNESDAY, MAY TWENTY-THIRD.

The morning session was called to order at 10.30 o'clock.

The paper on "Uniform Accounting," by Lieutenant J. B. Cahoon, took up first the necessity which is felt to exist for standardization of methods of accounting. It was largely the looseness of accounting methods that was responsible for the numerous sub-divisions of a method of accounting which he proposed. He had taken the time to lay out, step by step, a method of accounting that seemed to meet the requirements, and the details of this furnished the basis of his paper. A large number of blanks, balance sheets, statements and ledger pages were exhibited as part of the paper.

The reading and discussion of this paper occupied the entire morning session. The discussion was exhaustive and was participated in by Messrs. H. L. Doherty, St. Paul, Minn.; W. Worth Bean, St. Joseph, Mich.; Samuel Insull, Chicago; George B. Neal, Georgetown, Mass.; Edwin R. Weeks, Kansas City; F. Ellwood Smith, Somerville, Mass.; Ernest H. Davies, Williamsport, Pa.; Samuel Scovil, Cleveland; Walter M. Anthony, Chicago, and W. McLea Walbank, of Montreal, Canada.

On motion of Mr. Scovil the following resolution was adopted:

Resolved, That it is the sense of this association that the president and executive committee of this association shall appoint a committee to formulate a system of Uniform Accounting, and that this committee proceed with its work as promptly as possible so as to put the system of accounting to be recommended by the committee in printed form in the hands of the members of the association so that the report can be discussed intelligently at the next annual meeting of the association.

The meeting then adjourned until 2.30 P. M.

The afternoon session met at 2.30. Professor W. L. Robb read his paper entitled "Series Enclosed Arc Lighting for Street Lighting Service," which appears on another page of this issue.

The discussion was opened by Mr. H. H. Wait, of Chicago, who discussed the subject of distribution of luminous flux at great length and drew conclusions rather adverse to the alternating arc lamp as compared with the direct-current arc lamp. Referring to the discussion of the day before he pointed out again the danger of the tendency toward specifying minimum street illumination as this was direct encouragement to the Welsbach people. Mr. M. E. Turner, of Cleveland, said the best test for street lighting was not by the photometer. He gave the impression that his idea of a good practical test was to walk through the street and look at it. He related at some length his experience with alternating lamps which had been decidedly satisfactory.

Mr. George B. Neal, of Charlestown, Mass., said he was much pleased with the paper and gave some account of the experience of the Boston Electric Light Company. Mr. W. S. Hine said the Boston Electric Light Company had had very satisfactory experience with enclosed lamps. Mr. W. W. Hillman, of Schenectady, N. Y., spoke at some length of the experience of the Utica, N. Y., Electric Light Company, which claims to have saved $9.74 per lamp per year by substituting enclosed for open arcs. Trimming costs only $1.28 per lamp per year. The method of automatically washing and cleaning inner globes was also described.

A GROUP OF DELEGATES TO THE TWENTY-THIRD CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION. PHOTOGRAPHED IN FRONT OF THE ART INSTITUTE, CHICAGO.

lusion of municipal ownership. Looking far into the future, the author thought that only two paths lie open before the electric lighting industry; municipal ownership or private ownership under state regulation. Already in Massachusetts the latter idea has taken root and public utilities are there regulated.

The prime object of any system of accounting is that it shall be a true record of all the transactions relating to the business involved during the period of time covered. Central-station bookkeeping should aim to arrange these transactions under such headings and groups as to enable us to ascertain the cost of the product delivered to the consumer, the profit, the distribution of the costs into different accounts so that they may be studied with a view to economies and an arrangement of the whole system so that it will satisfy the demands of the accountant while giving the greatest information to the manager. The system should also be flexible and capable of expansion.

Lieutenant Cahoon then showed the

Mr. W. F. White, of Cincinnati, spoke concerning candle-power and watt comparisons. The discussion was continued by Mr. F. Elwood Smith, of Somerville, Mass.; P. D. Wagoner, Schenectady, N. Y.; and H. A. Wagner, St. Louis, Mo. At this point the president appointed Messrs. Samuel Insull, Charles R. Huntley and E. R. Weeks as a committee on nominations.

The following resolution was adopted:

The National Electric Light Association, representing in the capacity of its membership three hundred million dollars invested in the development of electrical industries, in annual convention assembled, has

Resolved, That the National Electric Light Association, feeling the great necessity for the establishment of a laboratory which would be able impartially to furnish authoritative standards, earnestly recommends the passage by Congress of a bill providing for the establishing of a National Standardizing Bureau.

Mr. Henry L. Doherty then read a paper entitled "Equitable, Uniform and Competitive Rates." This paper is a very clear-headed summary of methods of charging for electric current supply. The author takes up first the question of discrimination as between customer and customer. This, while perhaps not illegal, is certainly inexpedient; in this respect may be found the only difference between the business of selling electricity and that of selling any other manufactured product. He then took up the difference between the electric light and gas business and then in turn touched upon each method of charging that had been in common use, including in all seven. In each of these cases objections and arguments in favor of the method were cited. Mr. Doherty then laid down as axioms two laws relating to methods of charging. These are (1) that the minimum must not be less than the cost of production, and (2) the maximum must not be greater than the value of current to the consumer. Competition comes in the shape of daylight, isolated plants, mineral oil and gas. The author thought that too little consideration was given competition from daylight.

"The most frantic efforts in architecture are often made," said he, "to obtain natural light and ventilation, frequently at the sacrifice of economy of room in buildings. I believe many of our modern buildings could be lighted and ventilated artificially at less cost than the sacrifice of room often requires. Natural light is not always to be preferred to artificial light."

Mr. Doherty thought that bad methods of charging had cultivated the isolated plant to an appalling extent. An isolated plant generally robs the station not only of a large customer but of a long-hour consumer, and hence a profitable one. The competition in isolated plants should be considered more carefully than that from gas and oil, as these plants encourage the establishment of others and not infrequently grow into competing central stations. The maximum demand indicator system of rating was then entered into at considerable length and finished by suggesting a system of charging based on the readiness of the company to serve the consumer. In other words, the consumer should himself fix his maximum demand in advance at whatever capacity he pleases and suitable means should be taken to limit this. Three methods were suggested for the limit, these being fuses, circuit-breaker and an interrupter causing the lights to wink when the capacity paid for is exceeded. The charge for "readiness to serve" should be fixed at the minimum cost to the station of all fixed charges and fixed expenses. The author then gave an analysis of the results in a station for one year. He argued at length and with much ability in favor of the system he had specified. He also spoke of the important effect of low rates on the extension of the business of the electric lighting station.

"A low rate will tend to put many basement, hall and bath-room lights in constant use," he said. "Many people are too lazy even to press the button."

The discussion on Mr. Doherty's paper was participated in by Messrs. John F. Gilchrist, L. A. Ferguson and Walter M. Anthony, all of Chicago. The session then adjourned until the evening.

At 9 o'clock in the evening, in the Auditorium banquet hall, Mr. H. G. Reist, of Schenectady, N. Y., gave a lecture on "Alternating-Current Generators," illustrated with lantern slides. The paper is reprinted in full elsewhere in this issue. A large audience was in attendance and Mr. W. Worth Bean occupied the chair.

THE THIRD DAY—THURSDAY, MAY TWENTY-FOURTH.

President Carnes called the morning session to order at 10.30 o'clock. Captain William Brophy, chairman, presented the report of the Committee on Grounded Circuits. Other committee reports, comprising that from the Committee on Amendments to Freight Classification, Mr. James I. Ayer, chairman, and that of the Committee on Standard Rules, Captain William Brophy, chairman, were also read.

Professor George F. Sever read Mr. Elmer F. Sperry's paper on "Automobiles as a Source of Revenue to Central Stations." The paper was received with interested attention and a vote of thanks was passed to the author. Mr. R. S. Feicht, of Pittsburgh, then presented his paper entitled "Combination Electric Lighting, Power and Railway Work." Neither of these papers was discussed.

The convention then went into executive session and heard the report of the Committee on Legislative Policy, which was considered and discussed at some length.

When the topic, "Free Wiring," was announced, an animated discussion occurred which was participated in by several well-known central-station men. The report of the Committee on Standard Candle-Power of Incandescent Lamps, of which Dr. Louis Bell was chairman, was read.

The Nominating Committee, which had been appointed the previous day and which was composed of Messrs. Samuel Insull, Charles R. Huntley and Edwin R. Weeks, presented its report and the following officers were elected for the ensuing year:

President, Lieutenant James Blake Cahoon, of Syracuse, N. Y.; first vice-president, Louis A. Ferguson, of Chicago, Ill.; second vice-president, W. Worth Bean, of St. Joseph, Mich. Executive Committee, to serve until the close of the twenty-sixth convention: Charles B. Hunt, London, Ont.; Ernest H. Davis, Williamsport, Pa.; Henry L. Doherty, Madison, Wis.

The report of the secretary and treasurer was then presented and approved. This concluded the business of the convention, which adjourned at 1.30 o'clock P. M.

CONVENTION NOTES.

The Reception and Entertainment committees of Chicago have every reason to be satisfied over the result of their efforts, and the members of the committees received congratulations from all sides. The reception held Monday evening in the parlors of the Auditorium Hotel was one of the most largely attended ever held by the association. Music and a delightful repast added to the evening's enjoyment, and the gathering did not disperse until a late hour. The electromobile ride, and luncheon at Washington Park, on Tuesday, and the matinees and other entertainments for the visiting ladies, were carried out according to programme and were highly enjoyed. Some 25 electromobiles were supplied by the Illinois Electric Vehicle Transportation Company, through the courtesy of President Samuel Insull, of that company, and carried the visitors on a long ride without mishap of any kind.

The new office building of the Chicago Edison Company, and the Harrison street station of the same company, were visited by nearly every one attending the convention. The arrangements of the handsome office building were commented upon most favorably, and invaded by many electric light men, as was also the magnificent modern electric light station on Harrison street. Every privilege was accorded the visitors thoroughly to investigate and explore to their hearts' content, and an enjoyable luncheon was served.

The courtesies of the American Telephone and Telegraph Company, long-distance, and the Chicago Telephone Company were extended to the convention delegates at certain hours. The compliment was highly appreciated and the lines were used by the visitors from different points.

The limited train on the Pennsylvania Railroad, leaving New York, Sunday morning, May 20, brought into Chicago a delegation of about 25 electrical men. The trip was a very enjoyable one and the party being located nearly all in one car fraternized as the wide-awake electrical representatives always do. Among those in the party were: B. M. Downs, Brookfield Glass Company, New York; H. E. Adams, Philips Insulated Wire Company, New York; John Dale, Dale Manufacturing Company, New York; Charles Blizard, Electric Storage Battery Company, Philadelphia, Pa.; H. B. Kirkland, American Circular Loom Company, New York; P. M. Fletcher and E. W. Rockafellow, Western Electric Company, New York; F. H. Schlesinger, Peru Electric Manufacturing Company, New York; H. C. Roberts, Roberts Electric Company, Philadelphia, Pa.; Maj. Robert Edwards, Jr., Edwards & Company, New York; J. J. Gorman, Manhattan Electric Supply Company, New York; Frank W. Harrington and G. W. Swan, John A. Roebling's Sons Company, New York; G. L. Patterson, Stanley & Patterson, New York; C. I. Hills, Perkins Electric Switch Company, New York; John T. McRoy, McRoy Conduit Company, New York; George A. McKinlock, Central Electric Company, Chicago; H. B. Cutter and wife, Cutter Electric and Manufacturing Company, Philadelphia, Pa.; W. O. Turner, of C. S. Knowles & Company, New York; S. B. Swift, New York; A. N. Palmer, Norfolk, Va.

ALTERNATING-CURRENT GENERATORS.*

BY H. G. REIST.

Since the general introduction of alternating current followed the extensive use of direct-current machinery, it was very natural that the same type and method of construction used in the latter should be adopted, and revolving armature generators resulted. With the small sizes which were at first built and the moderate potentials of that time, these machines were satisfactory and there was little reason for any change; but, with the development of the art, various improvements and modifications suggested themselves, one of the most important being the introduction of machines with revolving fields. These machines offer many advantages of construction and operation, and are rapidly displacing the machines of the older form.

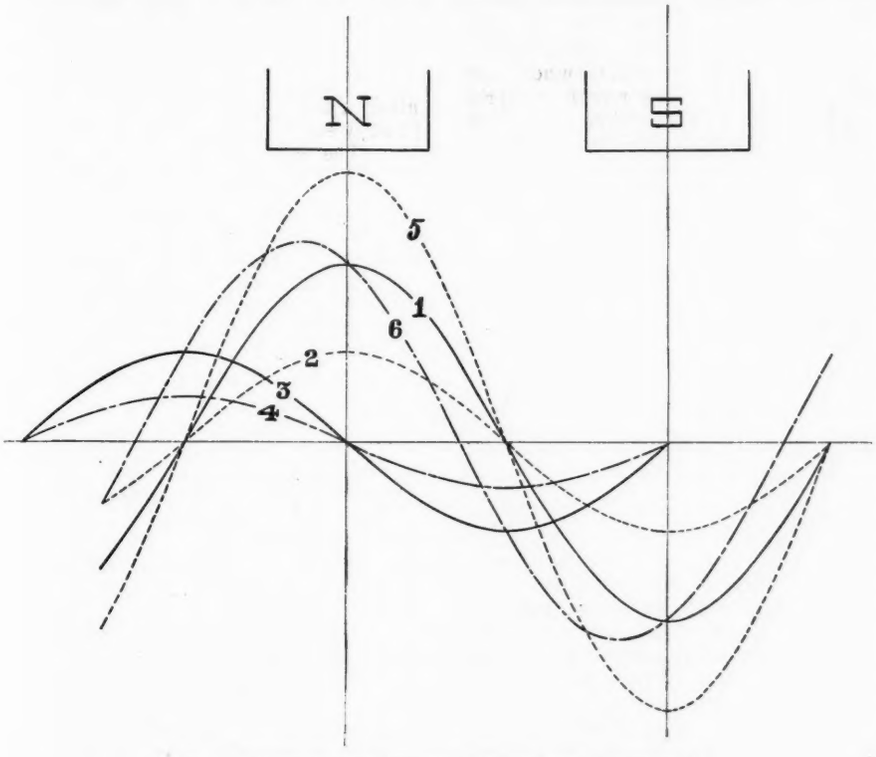


FIG. 1.—ALTERNATING-CURRENT GENERATORS—DIAGRAM A.

The regulation of the potential of alternating-current machines has always been an interesting problem and one for which a solution has been eagerly sought for some years. There have been various steps in solving this problem that may be briefly traced with interest. The first machines were separately excited but it was soon found that some form of automatic regulation was desirable, and methods of compounding were devised. This was done either by rectifying the line current or a current derived from a series transformer in the main line. For a load with a uniform power factor, this method of regulation is quite satisfactory, but with a mixed load of lighting and induction motors, it leaves much to be desired, since, if the machine is adjusted to regulate for a load of one kind, it will either over-compound or under-compound for the other condition. If the machine is adjusted to give the proper potential at the end of the line with a lighting load, it will be two low if motors are added. If adjusted for a motor load, it will be too high if lights are operated alone. It was with a view of rectifying difficulties of this sort that the compensated machine was devised. This was so named because it compensates or equalizes for loads of variable power factor, and will give the potential that the machine is adjusted for, whether the load is non-inductive or whether it is an induction motor load, or a mixed load, *i.e.*, you may have a load consisting entirely of lamps and the machine will compound to 2,300 volts at full load, or you may have a motor load and the same potential. The same is true if the load consists of half lights and half motors —always with a given load the potential at the generator will keep constant. This is a feature of very great value as will be appreciated by all who have operated alternating-current apparatus.

As stated above, the earlier alternating-current generators were usually built of the revolving armature type, the first machines having the winding placed on the surface of the smooth core, but later it was placed in slots of the then so-called iron-clad armature. This allowed of the use of entirely enclosed armature coils, thus making possible an insulated covering of a quality unknown in earlier dynamo construction, but the supporting of the coils on the revolving armature either by bands or by clamps or shield-rings of various sorts, was always a troublesome matter. The collector rings for the higher potentials have also been a detail to which there was considerable objection, both on account of the difficulty of constructing rings satisfactorily insulated for higher potentials and also on account of danger to the attendant. It is unusual to find machines having a higher potential than about 3,300 volts of the revolving armature type, largely for this reason. For very low potentials, on account of the large current to be taken from the collector rings, the revolving armature machine is also not suited.

With the introduction of revolving field generators, many difficulties that are inherent to the revolving armature machines have been overcome and a construction much more satisfactory in every way has become possible. We are now enabled to produce machines which have stationary armature coils which require comparatively little fastening in the armature and which may be wound for all potentials from the lowest to 12,000 volts or more, with entire satisfaction. In the case of high potential machines, the terminals are usually entirely enclosed so that it is impossible for the attendant to be injured by them either from carelessness or accident. On low potential machines the feature of having stationary armature coils is just as desirable since the current is led through stationary parts only and does not have to pass through brushes. The coils of the armature are wound directly into their final shape and then filled with insulating compound. The insulation consists of a number of layers of tape, the number varying with the potential of the machine, each layer being carefully coated with varnish, thus making a coil insulation practically air-tight and waterproof. On high-potential machines the insulation is so important a matter that it is usual to put only one coil in each slot, and also to reduce the number of slots per pole so that the total percentage of space occupied by insulation is not too great. This produces a winding in which there is more than one shape of coil. On smaller machines the so-called "barrel-winding" is generally used, because such machines are built of lower potentials—generally 2,300 volts. In this case only one kind of coil is used and when the coils are placed in the machine they produce a very symmetrical structure. The armature coils are held in place by wooden wedges, which are easily removed and form a thorough protection for the coils in case foreign matter should accidentally find its way into the air-gap. The advantages of stationary coils are very great as they are not subject to injury from mechanical strains produced by centrifugal force. There are no bands so their removal is a very simple matter, and lastly, the ends are free to the air on all sides instead of being bound down to a supporting head. On larger machines it is usual to arrange the armature so that it may be slid on rails in a direction parallel to the shaft until the armature and field are free from each other and either part is rendered accessible for repairs or cleaning. The extra space

* A paper read at the Chicago Convention of the National Electric Light Association, May, 1900.

required for this purpose is usually very small—since a part of it is always necessary for the collector rings supplying current to the revolving field. The armature core is usually built up of the best quality of thin sheet iron, carefully annealed and the laminæ insulated from each other by paper or japan.

The revolving field structure is a detail which has received some of the best thought of electrical designing engineers for the past few years. The pole pieces are made of punchings of heavy sheet iron about one-sixteenth inch in thickness, with a composition end plate, the whole fastened together by means of rivets, or in some cases with bolts. These pole pieces are fastened to the field ring by two methods—in belted machines by means of a projecting dovetail on the pole piece which enters a groove in the field ring, and is secured by keys with a very slight taper, so that by light blows of the hammer on this key a very secure fastening is obtained. In the case of slow-speed machines, where the centrifugal force is less and the diameters of the field rings greater, greater lightness and sufficient strength is obtained by fastening the poles by means of bolts. Except in the very small machines the field copper consists of a flat ribbon wound on edge, so that the coil is only one layer in depth, the outside surface of which is bare. Every turn is thus exposed to the surrounding air, and it is impossible to have a coil warm on the inside. The surface of the coils being flat, gives large bearing of the turns of the coil on the insulation, thus not allowing any opportunity for the windings to shift on each other and short-circuit. The turns are insulated from each other by sheets of paper. These coils form a striking contrast and improvement when compared with field coils of machines built heretofore.

By somewhat enlarging the diameter of the armature, the yoke of the revolving fields can readily be made large enough to serve as a flywheel for the generator. This, while making the cost of the generator somewhat greater than if a separate flywheel is used, still offers many advantages, so that it will probably soon be the usual construction of the engine-driven alternators. Some of the advantages of this form of construction are that the shocks due to sudden changes in load are directly transmitted from the pole pieces to the flywheel mass, and not, as with the older construction, through the arms of the dynamo spider, through the shaft, then out through the flywheel arms; the total weight of the parts on the shaft may be reduced, since only one hub and spider is required; the length of the shafts may be greatly reduced, thus also reducing its diameter, and the size of foundation and space occupied by the machine. This construction, moreover, makes a more compact and symmetrical piece of machinery than if a separate flywheel is used.

The above general remarks on revolving field generators apply equally to the line of compensated machines which has been developed by the General Electric Company, and to which I would specially like to call your attention. These machines, so far, have been built belted only, and the exciter mounted on the shaft of the revolving field, and in their design all the best features of years of experience have been incorporated.

The exciter of one of these machines has the same number of poles as the generator. They are wound for 60 volts on smaller machines and 125 volts on larger ones. The poles are stationary and the armature revolves as is usual in direct-current machines. The construction of the exciter is the same as in direct-current multipolar machines only on account of the small energy necessary for exciting, the parts such as the pole pieces and armature coils are very small. The armature coils in this case are also form-made and assembled into the open slots of the punchings. There are three taps in the exciter armature which are connected to collector

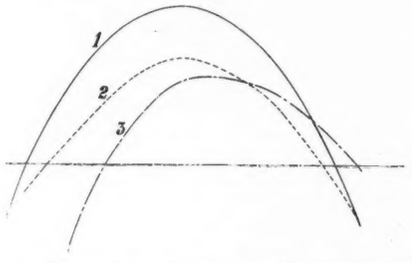


FIG. 2.—ALTERNATING-CURRENT GENERATORS—DIAGRAM B.

rings on the shaft—on the smaller machines on the outside of the bearing, and on the larger ones between the bearing and the armature, the use of which will be explained later on. The exciter is placed within the shield of the alternator which allows a construction to be used that does not destroy the symmetry of the machine and affords protection for the exciter. For direct-connected machines the exciter is mounted on the outboard bearing of the engine and is driven by means of enclosed gears. In this way an exciter may be used with a smaller number of poles than are used on the generator. The machine is entirely equipped with carbon brushes, and in all cases there are at least two brushes in multiple so that any brush on the machine may be examined, cleaned and replaced while the machine is in operation.

The bearings used in these machines are the usual spherical self-oiling, self-aligning bearings made of a heavy cast-iron sleeve, lined with anti-friction metal. The bearing next to the pulley is made especially large, both to insure stiffness of the shaft and to avoid wear and heating. The small bearing next to the exciter has only very light pressures on account of the long distance between bearings. The arrangement which has been adopted on these machines allows the bearings to be placed far apart, yet keeping the machine as a whole very compact, which is a very desirable feature on machines with two bearings. The oil rings of all the larger bearings are made split, so that they can be readily removed without taking the shaft out of the bearings if it is desired to do so.

It is well known that when the load on an electric generator, direct or alternating, is increased, the potential will drop unless the field excitation is also increased. This is due to the resistance of the armature, the inductance of the armature, and the reaction of the armature on the field poles, the latter reducing the amount of effective magnetic flux. The potential at a distant point, where the current is used for lights and motors, falls even more on account of the resistance and inductance of the line. To compensate for this, direct-current dynamos have been compounded by passing the main current through series coils on the poles and so adjusted that the potential at the machine increases with increasing load. On alternating and multiphase machines the same result has been obtained by rectifying the main or an induced current, and using it for the same purpose; and, except for a slight increase in complication, the method is just as effective as on direct-current machines, so long as the alternating current is in phase with the potential, which unfortunately is rarely the case in ordinary operation, since partly loaded transformers and induction motors produce a lagging current which requires a greater field excitation to produce the normal potential. Thus, in all types of alternators heretofore designed, the compounding required for non-inductive load has been entirely insufficient for inductive conditions. With the loads that ordinarily have to be provided for on alternating current circuits, there are wide variations in power factor, especially in cases where considerable proportion of the load is in motors. Therefore the introduction of automatic means of field adjustment for all kinds and degrees of load is of the greatest practical value. This is what is being obtained by this new method of excitation, which is based on a radically different principle from anything that has heretofore been employed and gives an automatic compounding far superior in results from that which can be obtained by any other known method and at the same time there is nothing but the simplest and most reliable mechanism used; in fact, without any mechanical change or adjustment. The devices by which this result is accomplished are mechanically simple. The shaft of the alternator which carries the revolving field also carries the armature of the exciter. The exciter has the same number of poles as the alternator, so that the two operate in a synchronous relation. Besides being connected to the commutator, which delivers current to the field of the alternator, and to the field of the exciter, the winding of the exciter armature is connected to three collector rings. Over these collector rings it receives current from one or several series transformers inserted into the lines leading from the alternator. This alternating current passing through the exciter armature and reacts magnetically upon the exciter field in proportion to the strength and to the

phase relation of the alternating current. In consequence thereof, the magnetic field and, hence, the potential of the exciter, is due to the combined effect of the shunt field and the magnetic reaction of the alternating currents. The connections between the armature of the two machines are so made that the poles induced in the exciter armature are somewhat ahead of the exciter field magnetization, but still so that they will assist the field magnets. The result is that with increasing current the current passing through the exciter armature strengthens the exciter field and thereby the field of the generator. If the current lags, as under an inductive load, the poles produced by the alternating current in the armature comes more nearly in line with the exciter field poles, thus strengthening the field more with a given line current. This is so adjusted as to give the necessary rise of exciter potential as the non-inductive load increases and without other adjustment to give a greater rise of exciter voltage with additional inductive load.

Diagram *A* showing the curves of magnetization of the exciter may enable us to understand the action of the alternating current that is passed into the exciter armature a little more clearly. Curve 1 may represent the magnetizing effect of the shunt winding on the exciter, and, assuming the fields of the exciter to be so placed that the magnetizing effect of the current through the armature has its maximum directly under the pole piece its effect might be represented by curve 2. It will be understood that this magnetic effect is stationary in relation to the exciter pole pieces, since the alternating current passed into the exciter armature is synchronous with its speed and is passed in such a way as to cause the magnetic wave to move in the direction opposite to that in which the exciter turns. In this case the combined effect or the sum of the two will be represented by curve 5, but ordinarily, the magnetizing effect in the armature is shifted with reference to the magnetizing effect of the pole. This is readily accomplished by turning the field structure of the exciter into such a position that the magnetizing effect of the armature leads the magnetizing effect of the field as is shown by curve 3, in which case it is shown to be 90 degrees ahead of the poles. Now, combining curve 3 with curve 1, it will be found to produce curve 6, which has a higher magnetic effect than curve 1 alone. Therefore, the potential of the exciter and also of the alternating machine is increased. If now curve 3 represents the magnetic effect produced with a non-inductive load, it will readily be understood that with a lagging current, *i.e.*, as the power factor decreases, the magnetic effect will shift from the position occupied by curve 3, towards the position occupied by curve 2, which would in this case represent the position of the magnetic effect of the same current with the power factor zero. As the curve shifts in position from 3 to 2, the sum of this curve combined with curve 1, which we have assumed to remain constant, will shift from the value of curve 6 to curve 5, *i.e.*, the magnetizing effect will gradually increase as the power factor of the circuit decreases, which is the essential feature in compounding for a load with a variable power factor. For less than full load, the current in the series transformer will be smaller and its magnetizing effect will be less, but its position will remain the same as is shown, for instance, in curve 4. Assuming, now, the non-inductive load to produce the magnetizing effect as shown in curve 2, it will be seen that when the field is placed in the position shown in figure, a maximum magnetizing effect will be produced and if shifted towards 3, or it will be equally true if shifted to the right, the sum of this curve and 1 will gradually be reduced. Until after it has been shifted 90 degrees, it will have the value of 6, and if shifted 90 degrees more, until directly opposing curve 1, the combined effect would be a reduced curve about equivalent to curve 2. Diagram *B* shows curves of the potentials at the terminals of the alternator produced by setting the exciter poles in a variable relation to the winding on the generator. Curve 1 represents a series of such potentials. Starting from a negative value, it increases to a maximum and then diminishes. If the machine is loaded with a current whose power factor is less than unity, the maximum effect, as well as the whole curve, is reduced and is shifted to correspond with the lagging current, as is represented by curve 3. It will be noticed that these curves have a point of intersection which is the correct point for setting the exciter fields, since at this point the compounding is the same for a non-inductive load as for an inductive load. The curve of a load with a power factor between 1 and 3 would fall between these curves and intersect curve 1 at the same point, so that this point of setting remains approximately true for all values of power factor. It will be seen from these curves that it is possible to so adjust the machine that it will compound for a higher potential with an inductive load than with a non-inductive or vice versa. Curve 2 represents the maximum potentials of a single-phase load corresponding to about 75 per cent of the three-phase full load rating of the machine and using the same series transformer. In this case the maximum compounding is not so high as in the case of three-phase current. This curve also intersects the three-phase inductive load curve 3, so that by setting the exciter fields to the intersection of these two curves we have a correct compounding for a non-inductive

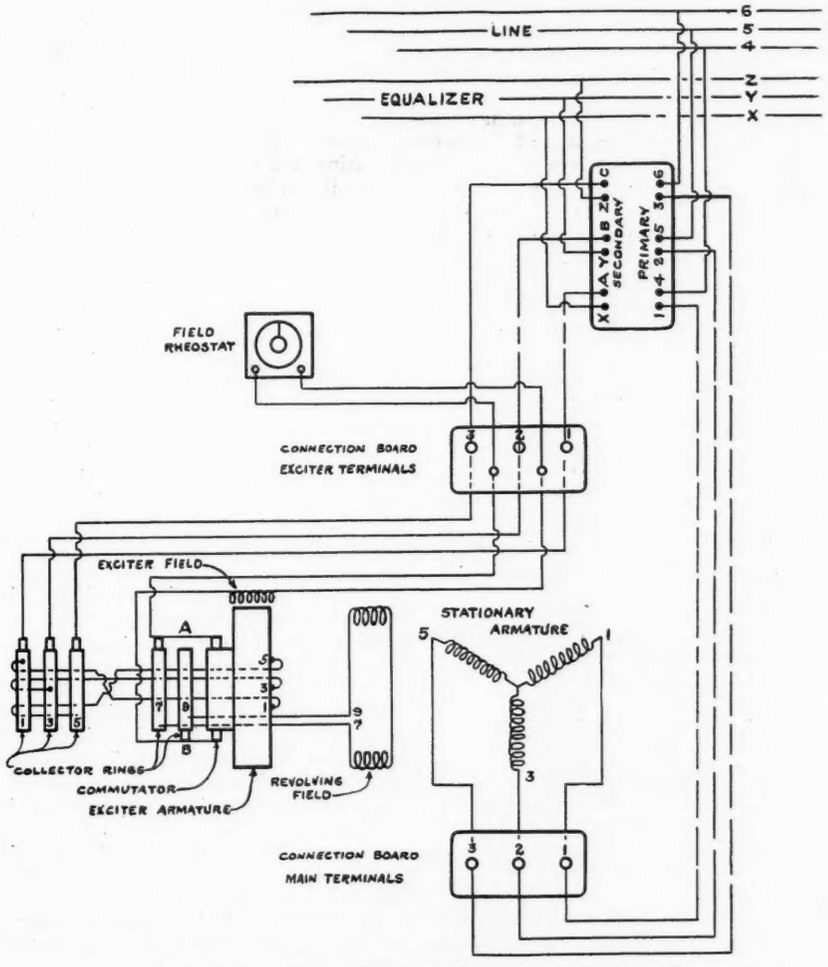


FIG. 3.—ALTERNATING-CURRENT GENERATORS—DIAGRAM C.

single-phase load and for an inductive three-phase load of a given power factor which is usually about 85 per cent.

As is the practice of the General Electric Company, all machines are tested before being shipped and are marked so that they can be set for either direction of rotation, for use with lights connected either in one circuit, *i.e.*, between two terminals of the machine or for lights connected in all three terminals, and, of course, for induction motors connected in three circuits in either of the above cases.

When machines are to be operated in multiple, the connections are made to equalizer bars as is shown in diagram C. They operate in this way very satisfactorily, not the least trouble being experienced. It is possible to operate machines in multiple with different potentials on the exciter.

As described above, these generators may be used very satisfactorily as single-phase machines for a lighting load on two lines and motors placed between the lighting terminals and the third wire. In this case the machines are adjusted so as to give a correct potential on the lighting circuit—whether the load is due to a lighting load or to a motor load. For small stations this is a very desirable method of installing a plant as only a single lighting circuit is necessary and the attention given to the machine can be reduced to a minimum. A second method of installation which has found considerable favor of late is to install a 240-volt generator, which is Y-connected, and which has a fourth wire brought out from the common connection. The lights on a machine of this sort are placed between the neutral wire and three terminals of the machine, arranging the lamps so as approximately to balance the load. This, however, is not very essential, as the unbalancing effect with this arrangement is almost negligible. For factory distribution work this is a very convenient arrangement, as no transformers are needed and the power and lights are distributed from the same circuits with a minimum amount of copper and with almost perfect regulation. The usual method of distributing a general system of lights from three-phase generators is to transmit the current over the line by means of three wires and to transform with the transformer primaries connected delta, and the secondaries Y, connecting the Y connections with a neutral wire and the whole to a system of secondary mains, and approximately balancing the lights in each important installation. In this way a very efficient distribution of the power is obtained with a minimum amount of copper and the generators are used to the best advantage as all branches are fully loaded and motors can be installed at any point. In large installations it is usual to have potential regulators in each branch to take care of slight unbalancing that may occur. These regulators may be made to operate automatically, keeping the constant potential at some distant distributing center, if it is so desired, or at the station. Two general types of potential regulators are used for this purpose. The magnetic regulator which is used in smaller sizes up to about six kilowatts, and the compensator regulator which is used on large sizes. In connection with the compensator regulator, an ingenious switch has been devised, which snaps from point to point, carrying current momentarily through an arc which, however, is interrupted immediately when the second contact is made.

Another use to which this machine can be put is in the operation of series enclosed arc lamps, which are so largely coming into use at the present time in connection with the constant-current transformers. Here the load is quite inductive, and it is hard to operate with incandescent lights without hand regulation, but the machine takes care of such loads perfectly.

In conclusion I will say that I have seen a 75-kilowatt belted machine start a 50 horse-power induction motor belted to another machine so that it had a considerable load with a fluctuation so brief on the lights as not to be noticed unless it was especially looked for, the voltmeter needle swinging perhaps five volts for a very small period of time, say one-tenth of a second, coming back again to its normal voltage, or in fact, to a higher potential than before, on account of the compounding, in a surprisingly short time. On observing the tachometer on the generator under these conditions, it was found that it also fluctuated, possibly due to the stretching of the belt as the load was put on; thus my conclusions are that there would be actually no fluctuation under these conditions with constant speed.

SERIES ENCLOSED ALTERNATING ARC LIGHTING FOR STREET LIGHTING SERVICE.*

BY PROFESSOR W. L. ROBB.

For a number of years previous to 1896 the arc lamp and arc-light dynamos remained practically unchanged, and most of us were disposed to consider this class of apparatus as having practically reached the stage of final development. No class of electrical apparatus has, however, undergone more radical changes during the past four years than that used for arc lighting. These changes have been brought about by the consolidation of numerous small plants, making it advisable to supply large areas from a single central station, by the introduction of the enclosed arc lamp and by the fact that the enclosed arc lamp made possible the successful use of the alternating-current arc lamp.

The enclosed arc lamp on constant-potential circuits has now been in successful operation for about four years. The series enclosed arc has been in equally successful operation for a period of two years. The superiority of the enclosed arc lamp has been appreciated by the general public, both when applied to interior lighting and when applied to street lighting. This superiority is not due to a greater mean spherical candle-power, this being undoubtedly very much greater in the open arc than in the enclosed arc when both are supplied with the same amount of energy. The superiority is due, rather, to the greater constancy of the light and its better diffusion, and to the relatively greater life of the carbon and the consequent infrequent trimming of the lamps.

In all long-distance transmissions of electricity, and when large areas are supplied from a single advantageously located power plant, we must, at least in the present state of the art, generate and transmit alternating current. In general, it will, in my opinion, especially if the wires are underground, be found desirable to supply the current to the street lights from the same secondary mains that supply the current for commercial lighting and power. This means that where low-tension secondary mains are in a street, we should do our street lighting with constant-potential enclosed, alternating, or direct-current arc lamps, the kind of lamp used depending on the kind of current used on the commercial circuits. There are, however, in all places, large areas in which the streets are lighted by arc lamps, and where there is no commercial lighting or power. These sections can be most economically lighted by series arc lamps.

Various methods of operating series arc lamps from alternating-current generating systems have been suggested, and are now in successful operation. These systems may be grouped as follows:

First—Synchronous or induction motors can be used to drive a line shaft, from which are belted the series direct-current arc dynamos that supply current to either open air or enclosed direct-current series arc lamps.

Second—Direct-current series arc dynamos can be direct-connected to either synchronous or induction alternating-current motors, and the dynamos used to supply current either to open or enclosed direct-current series arc lamps.

Third—The constant-potential alternating current supplied by the generators can be transformed directly by rectifiers into a constant-current direct current, and used to operate either series enclosed or open direct-current arc lamps.

Fourth—Series alternating enclosed arc lamps can be connected in series, with a reactive coil across the constant potential alternating-current circuit.

Fifth—The constant-potential alternating current supplied by the generators can be transformed directly by constant-current transformers in constant current, and used to operate series enclosed alternating-current arc lamps.

I have not included in the possible systems that in which the series arc lighting system is operated by its own steam plant,

*Extracts from a paper read at the Chicago Convention of the National Electric Light Association, May, 1900.

as it is practically the unanimous opinion that, with the present condition under which central stations operate, the best results are obtained when one kind of current is generated and this is transformed for the various kinds of service required.

The history of the electric lighting industry during the past two years seems to have demonstrated that in practically all sections of this country it is possible to replace the open-air arc with enclosed arc lamps, and give equal, or better, satisfaction when the same amount of energy is applied to each type of lamp. As the annual saving per lamp in trimming, carbons, inspection and maintenance of the lamps is approximately $10 it would seem to place the open-air arc out of consideration, and the question of a street lighting system resolves itself into which of the above mentioned systems should be adopted for operating enclosed lamps.

The system of street lighting that will be found best for any given city undoubtedly depends largely upon local conditions. But there are undoubtedly many cases where investigation will show that the adoption of the constant-current transformer and the series alternating enclosed arc lamp will at present offer the best solution of the problem.

We are at present operating in Hartford, Ct., 804 street lights. Seven hundred of these are operated from constant-current transformers on series alternating-current circuits. The remaining lights are operated from a constant potential Edison three-wire system. Eight constant-current transformers, each of 100-light capacity, are in use. Six of these have been installed in two transformer houses, at a distance from the central station, and are operated without any attendant.

Each transformer is enclosed in a cylindrical tank. The tanks were originally made of boiler iron riveted up. It proved impossible to keep tanks made in this way tight against the transil oil in which the transformer is immersed. The tanks are now made of cast-iron.

The core of the transformer is of the sheet type, with a large central vertical core rising the whole height of the tank. This central core is surrounded by primary and secondary coils, and the magnetic circuit is closed by return paths outside the coils. One of the primaries is fixed at the bottom and the other at the top of the central core. The two secondaries are free to move up and down between the primary coils, and are so connected that when one falls the other rises. They may approach into contact with each other at the middle of the tank, or from this position one may rise toward the primary coil at the top, while the other falls toward the primary coil at the bottom. Connected with the chains by which they are balanced is a lever, which extends outwardly from the top of the oil tanks and carries, suspended from its outer end, an adjustable weight. The lever is supported on a hardened steel knife edge. The weight tends to force the two secondary coils respectively toward the two primary coils. When the transformer is in operation the currents induced in the secondary react upon those in the primary, and tend to force the coils apart. This force is balanced for the desired normal current by the adjustable weight outside of the tank. The 100-light transformers are arranged to operate two circuits of 50 lamps each. The circuits are connected upon the multi-circuit principle first used with the Brush series dynamos. The transformer can be adjusted so as to give practically constant current from one-third load to full load. The regulation below one-third load is sufficient to prevent the current from rising to an extent that will endanger a single lamp if all the others should be cut out.

JAMES BLAKE CAHOON, OF SYRACUSE, N. Y., PRESIDENT, NATIONAL ELECTRIC LIGHT ASSOCIATION.—(See page 555).

The first lamps were trimmed every five days, but since adopting the caps now in use it has only been necessary during the long lighting hours of Winter to trim once in six days. The trimming is taken care of by two trimmers, and from the results obtained we find that one trimmer, with horse and wagon, can easily take care of five hundred lamps. This would make the annual cost of trimming, per lamp, at the Hartford rate of wages, two dollars per lamp, as against eight dollars, which was the cost per lamp when the open-air arcs were used.

The cost of carbons per lamp per year is $1.50 per lamp, against $5.84 previously paid for open-air arcs. The cost of inspection has remained unchanged.

The cost of inner globes now averages less than two globes per lamp per year, or about 30 cents per lamp. Both the breakage of outer globes and the repairs on the lamps have been considerably less, but the data accessible are not sufficient to permit me to state this saving exactly. The annual saving in trimming, carbons, and repairs made by replacing the open-air arcs with enclosed arcs has undoubtedly been greater than $10 per year per lamp. The service has been improved; the number of hours lights have been out has been reduced about 50 per cent. During the past six months the records show that out of 804 lamps, the "outages" amounted to 2.2 lamps out all the time. The service furnished by the enclosed arc lamps has been extremely satisfactory to the public and to the board of street commissioners having charge of the street lighting.

During the past month the rate at which cylinders have been renewed has been about eight-tenths of a cylinder per lamp per year. The smallness of the renewals is also in great part due to the fact that the cylinders are cleaned every time the lamps are trimmed, and consequently can be cleaned with a brush and hot water, and no acid is required for removing the deposit.

The success or failure of the introduction of enclosed arc lamps depends largely on whether the cylinders are kept clean. They should undoubtedly be cleaned every time the lamp is trimmed, and not at the lamps, but at the central station.

Under the usual conditions of street lighting the dynamos at all times carry at least 90 per cent of the full load, and at this load the efficiency and power factor of the constant-current transformer alternating system are satisfactory. The power factor is approximately the same as that obtained with induction motors at the average load at which they are operated. The low power factor at fractional loads makes the use of a constant-current transformer undesirable when the conditions are such that the transformer is not operated at a large part of its rated full load.

It has been found in practice that the transformers can be maintained and operated successfully with little attention. At Hartford, six of the transformers have been operated during the entire past year from two outlying sub-stations. There is no attendant at either of the stations. The inspector of the district cuts on and off the lights at the proper time and visits the sub-station once during the night.

The lamps that have been used in Hartford are of the carbon feed type, and differential. The power factor would be considerably increased if satisfactory shunt lamps were used. Lamps of this type, however, with which I have had the fortune to experiment, have not proved satisfactory when compared with the differential lamp, and it was considered that the differential lamp was a better one to use, even if its use reduced the power factor of the system several per cent.

(To be concluded.)

EXHIBITS AND EXHIBITORS AT THE CHICAGO CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

While there were no arrangements for an exhibition hall, many parlors and rooms in the Auditorium Hotel were used for the exhibition of electrical apparatus by manufacturers. These are mentioned below in detail:

The Central Electric Company, Chicago, distributed an interesting puzzle.

Crocker-Wheeler Company were represented by W. H. Wissing, of the St. Louis office.

The Chicago Insulated Wire Company, had Mr. William I. Smith as their representative.

Sangamo Electric Company, Springfield, Ill., had Mr. Ludwig Gutmann as its representative.

Municipal Construction Company, Marquette Building, Chicago, was represented by E. L. Draffen.

A neat aluminum stamp case, bearing the name of the new type Sunbeam lamp, was distributed to visitors.

Moloney Electric Company, makers of transformers, St. Louis, had Mr. T. O. Moloney to look after its interests.

McGill, Porter & Berg, dealers in electric railway supplies, of Chicago, was represented by several gentlemen of the company.

Chicago General Fixture Company, manufacturers of fixtures and metal work, were represented by General Manager Overbaugh.

The Kuhlman Electric Company, of Elkhart, Ind., manufacturers of the Kuhlman transformer, was represented by Mr. E. Kulhman.

Mr. George Cutter, of the George Cutter Company, manufacturers of arc insulators, street hoods, mast arms, etc., was a prominent visitor.

The Cutter Electric and Manufacturing Company, of Philadelphia, was represented by Mr. Henry B. Cutter, president of the company.

The New York Insulated Wire Company were very much in evidence in the person of Mr. James H. Wolff, their well-known western representative.

Gregory Electric Company, Chicago, was represented by the following: A. O. Kuehmsted, A. Louis Kuehmsted, R. H. Watson, and G. M. Ellis.

The Manville Covering Company, of Chicago, exhibited in connection with the H. W. Johns Manufacturing Company, steam pipe and boiler fittings.

Mr. Fred Howe Bostwick, of the Hendrie & Bothoff Manufacturing and Supply Company, of Denver, manufacturers of hoisting engines, was present.

Mr. Geo. T. Manson, New York, general superintendent, represented the Okonite Company. This company's souvenir was "made in Germany."

Mr. C. O. Baker, Jr., the master of transportation for the association, was unable to be present on account of the death of his mother, and was missed by every one.

A number of specimens of the McRoy conduits, made by John T. McRoy, of New York and Chicago, were shown. Mr. John T. McRoy in person was present.

Mr. Wilford G. DeCelle, late of Siemens & Halske, who has lately opened offices at 1233 Monadnock Building, Chicago, was prominent among the electrical men present.

Mr. T. J. Fleming, of Buenos Ayres, Argentina, who attended the convention with Mr. H. B. Kirkland, of New York, was probably the "longest distance" visitor in attendance.

Mr. Chas. Blizard, sales manager, of Philadelphia, and Frank W. Clark, represented the Electric Storage Battery Company, and were often consulted by the electric light men.

The Keystone Electrical Instrument Company, of Philadelphia, manufacturers of the standard line of Keystone instruments were represented by Mr. George C. Ewing, of the New York office.

The Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., makers of the C.-H. rheostats, distributed a unique little souvenir, and were represented by Mr. J. G. Hickox and Mr. F. R. Bacon.

Mr. B. J. Arnold, whose modern central station work has attracted widespread attention, was in constant attendance, and was prominent in extending greetings to the electric light men visiting Chicago.

Pass & Seymour, manufacturers of porcelain insulators and porcelain wiring specialties, of Syracuse, New York, were represented by B. E. Salisbury, manager, and John W. Brooks, western representative.

The Milwaukee Electric Company, Milwaukee, manufacturers of standard dynamos and motors, was represented at the convention by Walter Cary, vice-president. They report a very brisk demand for their product.

Messrs. W. W. Low and Thos. I. Stacey, of the Electric Appliance Company, Chicago, welcomed to their extensive house the visiting electrical men, and found time to greet many of their friends at the Auditorium.

Mr. D. H. Darling, Jr., secretary of the United States Battery Company, New York, made his maiden visit to the electric light convention, and found numerous friends of his storage batteries during the meeting.

The Bryan-Marsh Company, manufacturer of incandescent lamps, had parlors on the first floor adjoining the general reception rooms, and was represented by Messrs. Marsh and Jones, the latter of the Chicago office.

The American Electrical Works, of Providence, R. I., manufacturers of bare, magnet and insulated wires, were represented by the manager of the Chicago office, Mr. F. E. Donohoe, and also Mr. Edgar H. Hammond.

Mr. J. S. Crider, secretary of the Washington Carbon Company, makers of direct and alternating carbon points and carbon specialties, a gentleman who has for many years been identified with electrical interests, was present.

The Phœnix Glass Company, of New York, Pittsburgh and Chicago, manufacturers of electric, arc, incandescent and gas shades, reflectors, etc., were represented by Mr. A. H. Patterson, of New York, and Mr. Fox, of the Chicago office.

Dr. W. M. Habirshaw, the widely-known insulated wire manufacturer, of New York, spent several days at the Auditorium Annex. The doctor was greeted by a host of friends and his presence added to the social features of the convention.

Mr. Robert L. McOuat, successor to Varney & McOuat, dealers in electric supplies, of Indianapolis, Ind., was present. Mr. McOuat has just announced his successorship to the business. Mr. V. C. Grace was also present for the company.

The Standard Paint Company, New York and Chicago, manufacturers of the P. & B. compounds, distributed a very handsome souvenir in the shape of a combination pocket book, memorandum book and card case. These were eagerly sought after.

Mr. Frank H. Stewart, representing Frank H. Stewart & Company, the electrical supply house of Philadelphia, was at the Auditorium during the days of the meeting, and was an active participant in the meeting of the electrical supply companies.

A meeting of the electrical supply interests of the country, which was held in Chicago this week, kept a large contingent busy at sessions in the Edison Building during the day, but in the evening they all were present at the electric light convention headquarters.

Pettingell-Andrews Company, Boston, Mass., introduced at the convention a wiring tube known as the "Fin" tube, which conforms to the national code standard. This well-known New England supply house was represented by the president of the company, Mr. C. B. Price.

Mr. E. W. Gilmer and T. S. Lane, of the Warren Electric and Specialty Company, of Warren, Ohio, were present. This company distributed a well printed pamphlet and other advertising literature descriptive of the Peerless incandescent lamps, fan motors and transformers.

The office of the secretary occupied one corner of the parlor on the second floor of the Auditorium, and was presided over by Miss Harriet Billings, as assistant secretary, in a very satisfactory manner. Quite a number of new members were recorded, both associate and active, at this convention.

Thomas G. Grier, who for many years has been connected with the Western Electric Company, at Chicago, was a visitor. Mr. Grier has opened a new office at 200 Monroe street, and will represent a line of specialties, including the Dicke Tool Company, Wirt Electric Company and others.

The Wagner Electric Manufacturing Company, St. Louis, had Mr. George B. Foster, of the company's Chicago office, as their representative at the convention. Mr. E. H. Abadie, who usually attends these conventions, was unable to be present. The company is very busy with large orders.

The H. C. Roberts Electric Supply Company, of Philadelphia, was repre-

sented by Mr. Roberts in person, who remained at the Grand Pacific Hotel and is active in the general advancement of the work of organization which the supply dealers throughout the country are carrying through.

The Jewell Electrical Instrument Company, Chicago, showed a line of Jewell testing instruments for switchboard and portable service, which included milli-ammeters, milli-voltmeters, ammeters and voltmeters. Messrs. Willis and Jewell, of the company, were frequent visitors to the convention.

obtainable in arc lighting. These carbons are imported by Schiff, Jordan & Company, of New York, and are handled by them in large quantities.

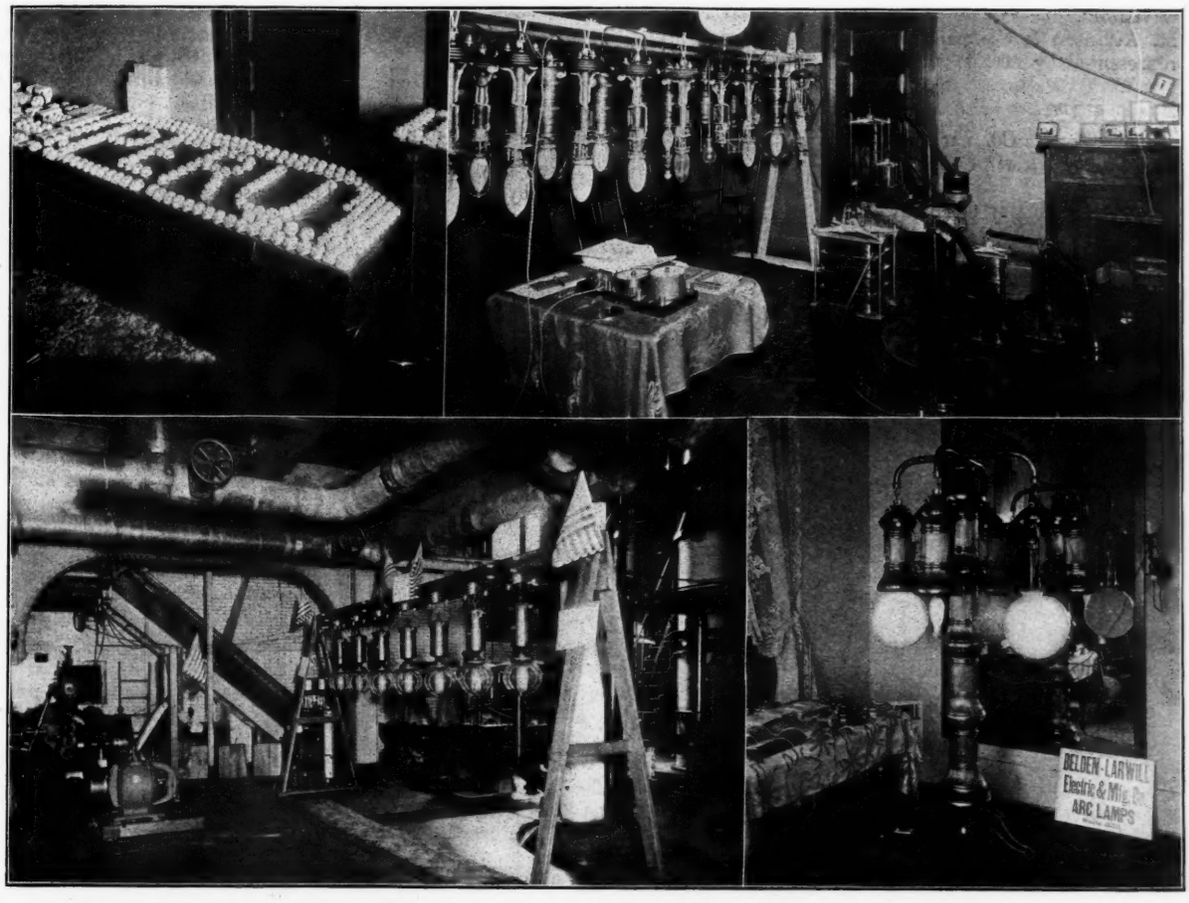
The Standard Underground Cable Company, of New York and Pittsburgh, which has offices in Chicago, was represented by the manager of the western office, Mr. J. R. Wiley. A parlor on the first floor was open for the reception of visitors, and a line of specimens of the company's product was shown.

Mr. W. D. Packard, secretary and treasurer of the New York & Ohio Company,

magnet cores are automatically wound by machinery. The "Varley" coils are widely used in the telephone manufacturing industry.

Mr. James I. Ayer, ex-president of the association, and general manager of the electric heating department of the Simplex Electrical Company, of Cambridgeport, Mass., was unable at the last moment to go to Chicago. This was regretted by all, as Mr. Ayer has always been an active and earnest member of the association.

John A. Roebling's Sons Company was



1. Peru Electric Manufacturing Company, Peru, Ill.
2. Manhattan General Construction Company, Newark, N. J.
3. Western Electric Company, Chicago.
4. Belden-Larwill Electric and Manufacturing Company, Fort Wayne, Ind.

A Group of Representative Exhibits at the Electric Light Convention.

The H. W. Johns Manufacturing Company had an exhibit of Sachs "Noark" fuses, asbestos electrical fittings and pipe covering. This company was represented by Mr. T. G. Younglove, manager of the Chicago branch, and Mr. E. H. Younglove and Joseph Sachs, of New York, and S. H. Finney, of Chicago.

Mr. T. H. Brady, the pioneer manufacturer of specialties for line construction work, such as mast arms, poles and swinging hoods, distributed literature. Captain Brady was not present in person, and the absence of several of the men who have been active at previous meetings was a matter of some regret.

"Ship" carbon was used by a number of arc lamp manufacturers who were making demonstrations of arc lamps with the idea of showing the most perfect results

of Warren, Ohio, was present and had an interesting exhibit in connection with that of the Electric Appliance Company in one of the rooms of the Auditorium Hotel, in which were shown samples of Packard lamps and transformers.

The National Arc Lamp Company, of Lorain, of Ohio, was represented by Mr. O. R. Moon. This company has just perfected a new alternating arc lamp which is claimed to be efficient, noiseless and simple, and constructed so that springs, solenoids, armatures, shunts, cut-outs, choke-coils and transformers are eliminated.

Mr. Richard Varley, Jr., of the Varley Duplex Magnet Company, Jersey City, New Jersey, spent the last two days of the session at the meeting. This company has an interesting system by which

represented by the following gentlemen from their various offices: H. L. Shippy, of New York; W. H. Slingluff, D. Foster Ivins, George C. Bailey, manager; A. B. Conover, Jr., F. W. Harrington, New York, and W. P. Bowman, manager of the Cleveland office, were also present.

The Illinois Electric Company, of Chicago, was represented by F. E. Healy, president; L. H. Cushing, secretary; Carl Keith, treasurer, and the following salesmen: Messrs. M. McNeil, Jr., D. D. Newman and H. E. Adams. This company represented the interests of the Warren Electric and Specialty Company, of Warren, Ohio.

The Interstate Electric Company, Cleveland, Ohio, manufacturers of the "Cosmos" arc lamp, was represented by

Mr. W. H. Pratt. This company has just passed into new hands, and new shops have been equipped for manufacturing this enclosed arc lamp. The company is now showing lamps for 110, 220 and 500-volt circuits.

The Safety Insulated Wire and Cable Company, of New York, manufacturers of the standard "Safety" rubber covered wires and cables for all characters of electrical service, was represented by its Chicago house, Messrs. M. B. Austin & Company, who had attractive and hospitable reception rooms which were well patronized by visitors.

J. M. Atkinson & Company, Chicago, were represented by Mr. J. M. Atkinson and Mr. W. E. Pimlott. Mr. Atkinson on this occasion was greeted by a number of his old-time friends. This company has lately opened new offices in the Marquette Building, Chicago, and represents a line of leading electric railway and lighting specialties.

Mr. A. C. Garrison, of the Columbia Incandescent Lamp Company, St. Louis, was among the well-known visitors to the electric light convention. There is probably no incandescent lamp made that is more widely known or that stands higher than the Columbia, and its friends and the friends of Mr. Garrison in the electric lighting field are legion.

The description and illustrations of the Boston Electric Light Company's central station, in the ELECTRICAL REVIEW, attracted much interest and favorable comment on the part of the central-station men present. The journal was much in demand and the article describing this modern installation received the attention that the subject so well merited.

The Warren Electric Manufacturing Company, Sandusky, Ohio, was represented by J. Holt Gates. This company has recently placed several large Warren alternators in the new electrical plant recently completed by Armour & Company, at the Union Stock Yards, Chicago. This plant was inspected by several parties of electrical visitors from the convention.

The Monarch Fire Appliance Company, of New York, was represented by Mr. Harry J. Doyle, superintendent of agencies, and General C. H. Barney, of New York. This company showed the wonderful fire extinguisher, "Kilfyre." This material is put up in tubes of perhaps two feet in length, is a dry compound, and acts with wonderful rapidity in quenching flames.

The Hewitt-Lindstrom Motor Company, of Chicago, was represented by the general manager, Mr. C. A. Lindstrom, and a number of electrical gentlemen enjoyed rides in the very easy moving and noiseless electromobile break manufactured by this company. The company will, in a short time, place on the market a number of very handsome electromobiles of different design.

Mr. C. E. Brown, of the Central Electric Company, and Mr. W. W. Low, of the Electric Appliance Company, of Chicago, entertained a number of the manufacturers and supply men at a banquet Wednesday evening at the Athletic Club, Chicago. Covers for 44 were laid. A number of responses to toasts were made by the gentlemen. The event was highly enjoyed and will long be remembered most agreeably.

The Lea Electric Manufacturing Company, Elwood, Ind., was represented by the company's engineer, Mr. Robinson, and the W. R. Garton Company, of Chicago, who is the western agent. The Lea Electric Manufacturing Company is the maker of the "Lea" arc lamp, which is receiving many excellent indorsements from electric light station managers and engineers who have put these lamps to practical tests.

The Jewell Electrical Instrument Company, was represented by G. Marpole Willis and Mr. Jewell in person. This company had a suite of rooms in the Auditorium, where portable switch ammeters and voltmeters for direct current were shown, of which they are the manufacturers. These instruments are claimed to be absolutely dead beat, and are said to be the only instruments on the market having adjustable dials.

Major Robert Edwards, Jr., representing Edwards & Company, of New York, manufacturing electricians, had rooms at the Auditorium Annex, where were on exhibition samples of a new automatic time switch, which is constructed so as to cut out only, or to cut in and out; also an automatic switch for branch circuits, or main feeders, which are controlled by push-buttons, operated by battery or higher voltage, was shown.

The American Circular Loom Company, of Chelsea, Mass., was represented by Mr. H. B. Kirkland, manager of the New York office, and Mr. J. W. Patterson, manager of the Chicago office. This company is having a season of splendid success with the flexible conduit "Circular Loom." This conduit has been approved by all the official boards of inspection throughout the United States, and is indorsed by leading engineers, architects and contractors.

The H. B. Camp Company, Akron, Ohio, were represented by Mr. A. L. Daniels. This company manufactures the Camp vitrified clay conduit, for underground telephone, telegraph and electric light works. This conduit is made in standard sizes, three inches internal diameter, and is laid with a patent mandrel, by which it is claimed a perfect alignment is insured. Mr. Daniels has been identified with electrical people and things for many years.

Messrs. M. B. Austin & Company, the supply house, was represented by Mr. M. B. Austin in person, and the following gentlemen: Arnold H. Friend, J. Lowrey Ellis and W. A. Browne. The company's reception room on the first floor was the centre of attraction for visitors, and the flowing punch-bowl was kept replenished. The company are western agents for the following concerns: Safety Insulated Wire and Cable Company, Holmes, Booth & Haydens, Safety Armorite Conduit Company and Elden circuit breakers.

The Bullock Electric Company, manufacturers of Bullock standard dynamos and motors, of Cincinnati, were represented by Mr. Frank G. Bolles, manager of the "advance" department. Mr. Bolles was entertained by friends, and not registered at the Auditorium. He distributed a most artistic and catchy brochure gotten up for circulation in Paris, containing an interesting description, in French and English, of the large and modern factory, also descriptions and illustrations of the company's standard type of generators and motors.

The United States Carbon Company, of Cleveland, Ohio, were represented by Mr. Cecil L. Saunders and J. W. Newcomer. This company had an exhibit showing the carbon specialties for electric purposes produced in its factory, and also specimens of carbon points for alternating, direct, enclosed and open arc lamps, together with specimens of electrolytic carbon. This company's factory is one of the newest and most modern in equipment of any in the world, and employs several interesting and exclusive processes in the making of carbon products.

The two establishments of the Woods Motor Vehicle Company, in Chicago, were visited by probably every electric light man in attendance on the convention. President Frederic Nicholls and General Manager C. E. Woods and other officials extended a cordial welcome and showed the visitors through the interesting works, where every part of the electric vehicles is made. Over 20 different styles were shown, all of the graceful design typical of Mr. Woods's work. Several new designs in which the absence of the horse was not the most prominent feature, were on exhibition for the first time.

The Sprague Electric Company, of New York and Chicago, was represented by the following gentlemen; E. B. Kittle, manager; J. Arthur Jones, F. S. Wilhart, E. B. Phillips, R. J. Sharpe and F. Elliott. The Sprague Company had a new model of the Lundell fans in operation distributed throughout the Auditorium Hotel. This company had also specimens of Greenfield flexible steel armored conductors used in wiring finished buildings and for open construction. Specimens of the steel armored cord for portables also were shown. These products are claimed to represent the latest and most radical advances in the art of electrical wiring.

The Westinghouse Electric and Manufacturing Company had a large party of gentlemen at the convention, among whom were the following: C. F. Scott, Pittsburgh, B. G. Lamme, Pittsburgh; R. S. Feicht, Pittsburgh; R. D. Mershon, New York; H. K. Archbold, New York; Calvert Townley, Boston; A. Hartwell, Chicago; W. S. Rugg, Chicago; C. W. Regeston, Chicago; T. P. Gaylord, Chicago; W. R. Pinckard, Chicago; Ervin Dryer, Chicago; Fred Nelson, Chicago; J. J. Gibson, Chicago; C. G. Burton, Chicago; G. Pantaleoni, St. Louis; C. B. Humphrey, Cincinnati; T. J. McGill, Minneapolis; T. A. Hall, Omaha; C. F. Medbury, Detroit, and B. Harding, Pittsburgh.

The Belden-Larwill Electric and Manufacturing Company, Ft. Wayne, Ind., had a commodious room fitted for the reception of visitors, in which had been placed a standard, uniquely constructed of lamp cases, from which a half dozen Belden arc lamps were burning. The Belden arc lamp is being energetically brought to the notice of the electric lighting field and many station managers were interested to see it in practical operation. The features claimed for the lamp are its lightness and simplicity of construction, attractiveness of appearance and the elimination of springs, sliding contacts and carbon rods. Messrs. Belden and Larwill and several other electricians from the company's factory were in attendance.

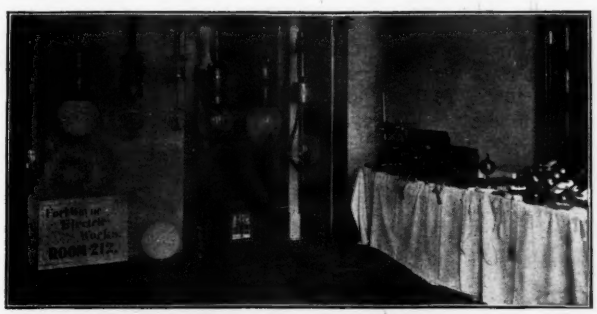
The Morris Electric Company, New York, showed a portable splicing machine in practical operation for splicing cables and wires. The press is hydraulic, and in one minute a cable of one million circular mils capacity can be completely spliced. The tensile strength of the splice is greater than the cable or the wire, and the conductivity about 50 per cent in excess. The machine is adapted so it can be put in a manhole for conduit work, or carried on a wagon for feeder splicing. Their plan is to lease the machine for its life and to sell copper splices, so that the cost of the splice complete is considerably less than the ordinary splice. No solder is used, consequently there is no heat to injure insulation. The company was represented at the convention by Geo. C. Ewing.

Mr. Chester D. Crandall, manager of the Western Electric Company, Chicago, kept open house at the great establishment in Chicago, and attended several sessions of the convention at the Auditorium. The immense office and factory buildings of the Western Electric Company were visited during the convention by a great many of the electric light representatives, who found much to interest them.

The Fort Wayne Electric Works was ably represented by Mr. F. S. Hunting and Mr. James J. Wood, the well-known inventor of the Woods systems of light and power. At the company's headquarters in the Auditorium an arc lamp 22 years old was exhibited, loaned for the occasion by Mr. C. E. Gregory, of Chicago. It attracted a good deal of attention from the electric light men, who compared it with the refined arc lamp of today.

The General Incandescent Arc Light Company, of New York, and the General Incandescent Lamp Company, of Cleveland, Ohio, had a very handsome exhibit, including in it samples of the numerous things the companies manufacture. The companies were represented by Samuel Insull, of Chicago; Martin J. Insull, of New York; Joseph Insull, of Cleveland; Frederick Raymond, of Chicago, and Thomas James, of Milwaukee. The exhibit included a specialty in a new patent sign lamp, a lamp which inserted in a socket makes an absolutely tight joint. Among other apparatus shown were knife and push-button switches, arc lamps for all circuits, incandescent lamps, Paragon fan motors, power motors and G. I. circuit breakers, Tailleur underground apparatus, Ferguson safety cutouts, Wright discount meters, rheostats, motor starting boxes, etc.

The Electrical Appliance Company, New York, was represented by the general manager, Mr. G. A. Nisbet. Literature relative to the gravity motor-con-



Fort Wayne Arc Lamps and Instruments.

Edwards Automatic Time Switches.

"G. I." Arc Lamps and "Paragon" Fan Motors.

Lundell Fan Motors and Greenfield Flexible Conduit.

A Few Representative Convention Exhibits.

The great establishment of the Central Electric Company was a general rendezvous and "rounding up" place for electrical guests of the city. The building had been prepared in advance for the reception of callers, and much interesting electrical apparatus of the newest designs was so arranged that visitors might readily find something of an attractive nature in nearly all the departments. Mr. George A. McKinlock, president of the company, and Mr. Charles E. Brown, secretary, devoted much time and energy to entertainment and reception matters. A large staff of gentlemen from the various departments of the company devoted themselves to the out-of-town attendants, and contributed largely to the general pleasure of the occasion.

Among those present representing the General Electric Company were the following gentlemen: Mr. J. R. Lovejoy, general manager of the lighting, railway and supply department; W. L. R. Emmet, engineer of the lighting department; B. E. Sunny, manager of the western office; W. S. Hayes, manager of the Cincinnati office; A. D. Paige, manager of the sales department of the Harrison Lamp Works; and Messrs. Hillman, Reist and Wagoner, of Schenectady; Beran, of New York; Judge, of Baltimore; Hanley and Dowd, of Cincinnati; Rosenthal, of St. Louis; Livsey, of Detroit; Bullen, of Boston; Ruddy, of Philadelphia, and Boyes, Scribner and Buel, of Chicago. The General Electric Company's headquarters were in the large south parlor on the first floor of the Auditorium Hotel.

troller, which it manufactures, was circulated. This company has taken in hand again the selling of this line of apparatus, which for a time has been in the hands of others. A saving of from 35 to 75 per cent is claimed for this automatic controller over ordinary hand rheostats, and special attention is directed to its extreme simplicity and durability. Mr. Nisbet mentioned that since it took into its own hands the control of sales, in February, the sales have increased 50 per cent. Among the large companies now using these devices in connection with belted electric elevators are the following: Western Electric Company, Crocker-Wheeler Company, C. & C. Electric Company, Martin J. Insull Company, Chase-Shawmut Company, J. C. Stearns. S. B. Condit, Jr., & Company are the New England agents for this line of apparatus.

The Helios-Upton Company had on display its product in storage batteries and enclosed arc lamps at the Auditorium. The battery exhibit consisted of 60 cells, the weight of each cell being 16 pounds, complete with elements and electrolyte; with normal capacity per cell of 85 ampere-hours, and with a high rate of discharge of 25 amperes for a period of three hours without any fall of potential. The batteries were connected up for the operation of direct-current enclosed arc lamps of three, four and six amperes consumption. The battery was delivered from the works of the Helios-Upton Company, in Chicago, completely filled and fully charged; hence this exhibit was the only one supplying electricity independent of the plant of the Auditorium Hotel. For this reason this particular exhibit commanded the attention of all the delegates and representatives to the convention. The exhibit was in charge of Mr. Wm. Hood, general sales agent for the company, also represented by Mr. King Upton, of Salem, Mass., managing director, and Mr. Thomas Spencer, superintendent for the company at Philadelphia, and Mr. George H. Stout, western manager for the company.

The Western Electric Company's exhibit comprised a series of seven series enclosed alternating arc lamps operated directly from the mains of an alternator giving 520 volts at 125 cycles per second. Under these conditions the lamps will operate with an average of 400 watts at the arc with a current of six and one-half amperes. The lamps are adapted for operation with any desired number in series, and where it is desired to vary the number from time to time, regulable transformers, either booster, step-up or step-down transformers, can be used, and in cases where the changes are very frequent, an automatic regulator is installed to operate the regulable transformer so as to maintain the current constant at any load. Under the above conditions the system will operate with an absolutely constant power factor at all loads. With the frequency of 125 cycles the system can be operated with a power factor of 82 per cent, and at a frequency of 60 cycles, 86 per cent. The lamps may be operated at their full wattage or at any point from that to 50 per cent lower by simply changing the voltage at the terminals of the series. This can be done manually if desired. The current strength changing with the voltage of the lamps tends to maintain the arc stable and of good color and illuminating power, regardless of the power at which the lights are operated.

In presenting the Manhattan exhibit, it was necessary to install a 50-kilowatt alternator with a direct-current motor to run it. For the circuit of lights on the poles in front of the hotel some 2,000 feet of lead cable was run; while for the circuit of lamps on exhibition in the parlor a large amount of inside wiring had to be done. The two circuits on exhibition running one from each phase of the two phase alternators were at a pressure of 1,100 volts each and were governed each by a 12-lamp regulator. The noticeable features of the system are as follows: The lamps are of the shunt type, carrying no springs and self-adjusting to variations of current in the circuit. The current in each circuit is set by adjusting the weights of the regulator for any desired value, and no attention need be paid to the lamps. There was also on exhibition in series with the other lamps, one of the Manhattan Company's old type differential lamps. A noticeable fact was that as the current was varied at the regulator from 5 to 7 amperes the differential lamp would be either completely closed at the arc, or would be drawing an excessively long arc, showing the manner in which this lamp is affected by change of current. There were also on exhibition regulators for 100 lamps (8,000 volts), 50 lamps (4,000 volts), 12 lamps and 5 lamps. Owing to the simplicity of the lamps, the absolute operation of the cutouts, and the simplicity and flexibility of the regulators, it would seem that this system embodies distinct advantages for central station work. The exhibit was in charge of Mr. S. Marsh Young, general manager of the company; Mr. Max Harris, sales agent; Mr. M. H. Baker, engineer and designer of the system, and Mr. F. L. Merrill, who represents the company in Chicago.

The Fort Wayne Electric Works, of Fort Wayne, Ind., had a very interesting exhibit under the direction of Colonel Chas. A. Munson, assisted by Mr. A. L. Searles and Mr. Frank McMaster. Mr. Hunting, general sales manager, and Mr. Wood, the electrical engineer and inventor, also devoted considerable time to their many visitors, explaining and describing the different new features on exhibition. These included an automatic motor starter, which combines with the over and underload release, a double-pole circuit breaker, completely cutting the motor and apparatus out of circuit in case of emergency; two styles of new arc light suspension cutout for series and constant potential circuits; new primary fuse boxes and cutouts, which show marked improvement in construction, and especially in the method in which they are mounted, which gives the most perfect insulation, as well as protection in case of burn-out. The company also showed several styles of arc lamps, which are ingenious adaptations of the single mechanism. These included the ordinary single arm open arc lamp for Chicago, the lamp designed for Jackson Boulevard, the Chicago series long burning lamp, for which the company has just received an order for 500; the arc lamp for the city of Detroit; the lamp which is fast being introduced in the city of Cincinnati, as well as the ordinary long burning lamp, and the very latest lamp, called the 1900 type. These lamps show a great improvement in design and construction, as well as adaptability to the purposes for which they were designed. The company also exhibited two commutator truing devices, which are designed for use on any of its dynamos, and are especially adapted for truing the commutators of street car or other motors. Among the interesting literature was a souvenir containing 100 pictures of the different styles of apparatus designed by Mr. Wood. The souvenir clearly illustrates the advance that has been made in dynamo construction since 1879 to the present time. Another souvenir, which was in great demand, was a little book slate and pocket memorandum; in addition to which was a large assortment of bulletins describing the various pieces of apparatus manufactured at the Fort Wayne Works.

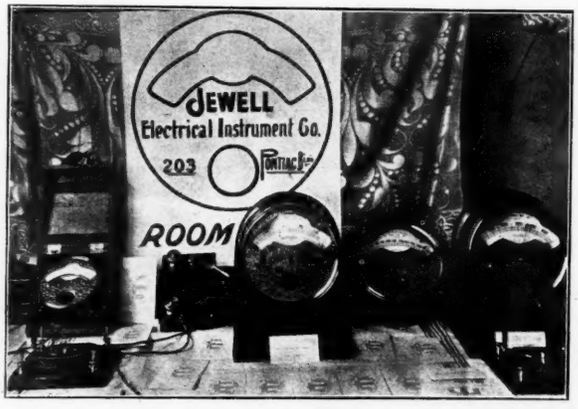


EXHIBIT OF THE JEWELL ELECTRICAL INSTRUMENT COMPANY.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.*

THE PROCEEDINGS OF THE SECOND AND THIRD DAYS' SESSIONS OF THE GENERAL MEETING AT PHILADELPHIA.

On the evening of Wednesday, May 16, a "smoker" was given to the members and guests of the Institute by the Manufacturers' Club, of Philadelphia, in its handsome club house on Walnut street. Refreshments were passed around and a vaudeville show of much merit performed.

THURSDAY, MAY SEVENTEENTH.

The meeting was called to order promptly at ten o'clock, President Hering in the chair. Dr. A. E. Kennelly read the report of the committee on units and standards, which was as follows:

To the Council, American Institute of Electrical Engineers.

Gentlemen: Your Committee on Units and Standards has considered the following resolution passed at the last regular meeting of the Institute on the 28th of March, 1900:

Resolved: That the Committee on Units and Standards be requested to investigate and report at the ensuing meeting in regard to the advisability of the following:

1. The giving of names to the absolute units of the electrostatic and electromagnetic systems.
2. The denotation by means of prefixes of multiples of such units.
3. The rationalization of the present system, by means of taking the absolute unit of magnetism as equal to the present magnetic line, and the absolute difference of magnetic potential as equal to the present absolute unit of current-turn.
4. The advisability of taking up any or all of the above matters at the congress to be held in Paris this year.

The committee desires to report as follows:

1. We consider that there is need for names for the absolute centimetre-gramme-second units in the electrostatic and the electromagnetic systems; also for suitable prefixes to denote decimal multiples and submultiples of these units, in supplement and addition to those already in common use.
2. That the International Electrical Congress, convening this year at Paris, should be urged to bestow the above mentioned names and create said decimal prefixes.
3. That much advantage would accrue to a universal "rationalization" of electric and magnetic units, and that the congress be requested to consider the means and advisability of such "rationalization."
4. That we recommend that the whole subject should be brought up as a topic for general discussion at the approaching general meeting of the Institute, in Philadelphia.

Signed: F. B. Crocker, W. E. Geyer, G. A. Hamilton, A. E. Kennelly, Chairman, and W. D. Weaver.

Dr. Kennelly said, in advocating the report of the committee, that it is certainly not harmful to name the units and that the names might be very useful. "A buttercup," he said, "is just as well called by its Latin name *ranunculus bulbosus* as No. 5314 in somebody's catalogue." The decimal system of multiples and submultiples extends through only five multiplications and four sub-divisions, which makes the scientific world look somewhat like the African savages who can count only to five, everything beyond that being, to them, "many." If a rational system was adopted, the centimetre-gramme-second and practical systems could be brought together so that practical work would be based upon a scientific system. The worst that could happen to the names adopted would be that they would fall into harmless and innocuous desuetude.

Dr. Kennelly also spoke at some length of Professor Fessenden's proposition to call the permeability of air 4π instead of unity. In this case the troublesome 4π will cancel out in most equations and disappear. As to this suggestion, the committee would like to receive advice.

President Hering said that the approaching congress at Paris was not a place for the discussion of new ideas, but rather a place for the adoption of suggestions already thoroughly discussed and ventilated. He recalled the experience of the 1891 Frankfort conference, where a hopeless attempt was made to adopt certain new ideas. It was desirable, he thought, to formulate the suggestions of the Institute now, and let the European delegates have them in time to think them over. There could be no objection to a new system of rational, physical units for the benefit of scientists. If such a system is good it will find its way into practice, As far as practical units are concerned, new ones are unnecessary. We seize upon such as we desire, and as are most convenient.

Mr. C. O. Mailloux recalled some ancient experiences before the 1881 congress, at which time the name "ampere" had not been used, the practical unit of current flow being called "weber." It was decided to give the name weber to the centimetre-gramme-second unit of current, which is 10 amperes, at this conference, but the word was forgotten, there being no occasion for its use. Later this Institute proposed the same word as a name for magnetic flux. All that is necessary is a logical and practical system of prefixes and names. Such names as kilowatt and microfarad are not objectionable in practice. Professor W. E. Goldsborough said he was much in favor of naming electromagnetic units, but great care should be taken in selecting the names. He thought that coming generations would thank us for making these changes and straightening out the mental concepts of those beginning to learn electricity. We should go before the International Congress with names that will receive approval and sanction. Professor W. S. Franklin said that rationalization ought to interest all electricians because one of the most irrational things in the world is the fact that they use two systems. "We are not ready yet to drop this for a perfect system, because we do not know enough. We do need names for the centimetre-gramme-second units, many teachers having found out that students have trouble because these units have no names."

Mr. Steinmetz thought it too late to make changes. Neither the Greek nor the Latin languages have names for the figure 1,000,000,000. The assumptions on which both the electromagnetic and electrostatic systems are based are wrong with reference to one another. A rational system would probably be one on a gravitational basis, but to change would introduce vast confusion. Mr. Mailloux suggested that such names as "deci-milligramme" could be used for sub-multiples. Professor A. J. Rowland said the question was important according to the point of view. The units would be valuable to scientific men but not to engineers. He spoke of the present confusion caused by the mixture of English and metric systems, as, for instance, when magnetic flux was stated it required the context to determine whether it was meant to be in square inches or square centimetres. Mr. Steinmetz related experience he had in trying to introduce the metric system in his work at Schenectady; he found that he was in a hopeless minority as the factory resolutely hung on to the inch and pound system to which he finally had to come.

Upon motion of Professor Goldsborough, the report was accepted and adopted and ordered transmitted to the delegates for presentation at Paris.

Mr. Fitzhugh Townsend then read his paper entitled "Eddy Current Losses in Transformers." The paper was an attempt to show that eddy current losses are proportional not to the square but to the 1.6th power of magnetic induction. The author described a number of experiments and showed a number of curves in which the result obtained in practice and then calculated by the new theory showed remarkable concordance.

Opening the discussion, Mr. Steinmetz said that he considered eddy currents the same as any other induced currents and could not agree with the author's reasoning and conclusion. He adduced a large mass of experience in support of his position and made some interesting re-

* A complete report of the Annual Meeting and the first day's proceedings at the Philadelphia General Meeting of the Institute, appeared in the Electrical Review for May 16, 1900.

marks concerning the general character of exponential laws. Professor Goldsborough closed the discussion with brief remarks concerning the distribution of flux in the core of a transformer.

The next paper on the programme was that of Dr. M. I. Pupin, but on account of the author's absence this was postponed and Professor Samuel Sheldon's paper on the "Conditions of Electrolytic Corrosion in Brooklyn," was substituted. This proved to be one of the most interesting papers read at the meeting. It described practical conditions as discovered in very comprehensive tests of the electrical condition of buried metals in Brooklyn taken in connection with the distribution of electric current for street railways in that city. Some extraordinary facts were brought out. For example, between the two ends of the Brooklyn Bridge a potential difference of as much as 20 volts has been noticed. The author thought the amount of corrosion taking place under given voltage conditions would depend upon the resistance of the soil and the nature of the surface of the pipe. A cast-iron pipe is covered with a silicious skin; this has a high resistance, and effectually prevents a flow of current from the surface.

The discussion was opened by Dr. Kennelly, who said that joints in water mains and gas mains were usually of high resistance, while those in service pipes, made by screwing the sections together, are of low resistance, and this would account for much of the destruction of service pipes. Professor R. B. Owens inquired about the conductivity of cast-welded joints and Mr. Robert Lozier was anxious to know if the auxiliary generator method had ever been used with satisfaction. Professor Sheldon explained that no such system was possible in Brooklyn, because of the diverse and frequently hostile interests which controlled the various kinds of pipes and current-carrying wires.

At this point an adjournment was taken to visit Cramp's shipyards, and attend a "planked" shad dinner. Two small steamboats were taken at the Arch street wharf, the party being met at the Cramp shipyard by a member of the firm and several gentlemen who acted as guides, and taken through all the various departments of that enormous industry. The party then reembarked and went down the river to Washington Park, about eleven miles below Philadelphia, on the New Jersey side. A lunch of sandwiches and beer was served on the boats. The party arrived at Washington Park about four o'clock and saw the shad caught to the number of three wagon-loads. They then waited and cultivated an appetite for about two hours and a half, while the shad were being "planked." The dinner was one of the best, if not the very best, that the Institute has ever enjoyed, both in the quality of the food and service, and in the good-fellowship which prevailed. It was a happy occasion that reflects much credit upon the entertainment committee of Philadelphia. The master of ceremonies, or rather of informalities, was Mr. Charles A. Bragg, of Philadelphia, well known to all the Institute. The speakers were Messrs. A. E. Kennelly, R. W. Pope, A. J. Rowland, G. S. Dunn, C. P. Steinmetz, William Cramp, S. E. Whitaker, Oberlin Smith, Patrick B. Delaney, and C. O. Mailloux. The dinner wound up with the usual singing of "Auld Lang Syne," the vocal music being continued all the way up the river as the party came back.

FRIDAY, MAY EIGHTEENTH.

The meeting was promptly called to order, the first proceeding being a resumption of the discussion of Dr. Sheldon's paper. Mr. C. J. Reed spoke of the electrochemical theory involved in the presence in the earth of buried metals, and stated that a water-pipe system in conjunction with other buried metals, could sometimes become a gigantic battery

The first paper was that by Professor F. A. C. Perrine, and Mr. F. G. Baum, entitled "The Use of Aluminum Line Wire and Some of the Constants for Transmission Lines." The paper was very long, deeply mathematical, and was presented practically in full, requiring about two hours. Little or nothing was said in its presentation about aluminum line wire. The discussion, which was on a plane above the comprehension of ordinary mortals, was conducted by Messrs. Steinmetz and the authors. Dr. Kennelly spoke of the importance of purity in aluminum line wire, and stated that the presence of alloy, which was more often impurity, rendered a wire brittle and non-homogeneous. Mr. P. N. Nunn stated that he had had a large experience with such line wires in the past and that he had reached the general conclusion that alloyed aluminum is not safe for this purpose. He spoke of a certain line of six miles in length, which broke once in every span of the line during the first month of its existence, and kept four men busy repairing it. These breaks, he said, were sharp and crystalline, and showed no signs of elongation. The wire broke like glass. He concluded that the alloy was not thoroughly incorporated, and said that during the manufacture of the wire it seemed to arrange itself in thin transverse strata in the wire. Under wind vibration or tension far short of the capacity of the aluminum part of the wire these weak places give way. He had found that the alkali of the western plains and the salt air of the coast seriously affect the wire.

Upon motion of Mr. G. S. Dunn, a committee consisting of Messrs. C. W. Rice, G. F. Sever and W. W. Kerr, were appointed to draw up appropriate resolutions of thanks for the hospitalities extended by the Philadelphia committee.

The next paper was that by Professor A. C. Crehore and Captain G. O. Squier, entitled "A Practical Transmitter Using the Sine Wave for Cable Telegraphy; and Measurements With Alternating Currents Upon an Atlantic Cable." This was one of the most interesting papers that has ever been presented before the Institute. It was illustrated by the apparatus involved, which were exhibited in practical operation. In brief, the method is as follows: The ordinary cable transmitter sends what is equivalent to square-shaped current waves into the receiving end of the cable. The square wave is, of course, composed of simple, harmonic components, but the damping action of the cable increases so rapidly with the frequency of these that practically only the fundamental vibration is received at the other end. Now, in practice, the operation of a cable is limited strictly by the electromotive force which can be impressed upon it. In the transatlantic cables it is not permitted to use more than 50 volts. If 50 volts is sent in as a square top wave it will come out as a sine wave which will be precisely the same as if a sine wave of a less voltage had been impressed. If, then, a sine wave of 50 volts maximum voltage be impressed, more energy will be delivered at the sending end and the cable can work faster. This gain was stated by the authors to amount to a substantial value, though they were not at liberty to give accurate figures. In opening the discussion, Dr. M. I. Pupin highly commended the interesting and valuable labors of the authors. Mr. P. B. Delaney said that the speed of signals depends largely upon the relation between the duration of contacts and the duration of breaks. He described some interesting experiments with adjustments undertaken in past years. He thought the advantages of the sine wave system more apparent in sending letters. consisting of consecutive signals rather than those consisting of signals of opposite polarity. He regarded the paper as admirable for the scientific data it con-

tained. Dr. F. E. Bedell stated that the advantages of sine wave current form were beyond controversy, but he thought that the wave ought to be all on one side of zero—such a wave as could be made by a synchronous rheostat; then transition from a positive wave to a negative wave would be through the zero point and there would be no sharp corner in the curve anywhere.

An adjournment of 25 minutes was taken at this point for luncheon, which was served by the committee on entertainment in one of the lecture rooms of the Drexel Institute. After the intermission Professor Crehore replied to some of the speakers. Professor W. S. Franklin pointed out that the circuit was broken only at zero points.

Mr. Steinmetz said it was remarkable how little attention had been paid to the generating part of telegraphy, the oldest branch of electrical engineering. The successive half waves of this system were in effect a double frequency current. The cable was therefore acted upon by two currents of different frequencies. In reply to a question by Mr. W. J. Hammer, Captain Squier said the system had been in commercial use on the Atlantic cables several days at a time, but that he was not at liberty to say more than that a material gain in speed had been made. Dr. Kennelly said that this was the first practical check upon the theoretical work of 40 years. During fifteen years past little progress had been made in the speed of cables. He spoke of the siphon recorder as an alterating-current power. In transmitting intelligence it was not necessarily the amount of energy that was received but its distinct arrangement that was valuable; it is not the wattmeter, but the eye that has to be satisfied. Some further remarks were made by Messrs. Delaney, Steinmetz, Owens and the authors.

An adjournment was then taken to another room in which a lantern was available, the first paper being Professor M. I. Pupin's, entitled "Telephony Over Cables, and Long-Distance Air Lines." This paper is one certainly destined to become historical, and is one of the most valuable, both from a scientific and commercial point of view, that has been read before the Institute during its history. On this page an abstract of its first part, which is an explanation of the second, or mathematical part, is begun. The author wisely refrained from attempting to read, at a general meeting, the extremely mathematical portion of the paper. He illustrated how it was possible to double or triple the distance over which telephony is possible, and how possible to telephone to great distances on ocean cables.

The discussion was a series of congratulatory and commendatory remarks. President Hering said that the paper made no extravagant claims such as ability to talk across the Atlantic cable but verified the theory. Mr. Steinmetz said that it was an important paper, marking a long step in advance. He spoke of the fact that three papers had been presented on transmission of alternating currents for such widely different purposes. There were currents of high frequency, high voltage and great power for power transmission; of low power, intermediate voltage and very low frequency for cable signaling, and now this paper dealt with currents of very low power, low voltage and high frequency for telephone transmission. In reply to a question by Professor Crehore, Dr. Pupin said that, on the cable he had been working with, the energy transmitted when the cable was arranged according to his system was about two per cent of that impressed, under ordinary conditions about one five-hundredth of one per cent or less. The author said that he *did* claim to be able to telephone over ocean cables and would consider a 1,000-mile transmission nothing remarkable. He showed how the system he had described could be applied to the cable signaling method of Messrs. Crehore and Squier, and that this could then be operated at from 650 to 1,000 periods per second instead of six or seven periods as at present. Dr. Pupin stated that he had tentatively devised a cable for transatlantic telephony, taking the ordinary cable which was 0.3 microfarad capacity and four ohms resistance per mile. It would require the addition to make it distortionless for frequencies up to 750 cycles, of 0.3 henries self-induction per mile. Such cables could be made, having cores six inches long and one and one-half inches diameter, of very fine iron wire and on these 40 turns of the copper conductor of the cable. Twenty-five coils of these dimensions would add one ohm to the impedance of the circuit. It is not ocean telephony, however, that is so important. Long land-line work is commercially very desirable and important. The limit at present may be said to be 1,200 miles, or about the distance from New York to St. Louis. Conversation at this distance is comparatively difficult, and beyond it hardly possible. The two-ohm per mile circuit between New York and Chicago cost $250,000. A circuit over which speech could be transmitted in the present way between New York and San Francisco would cost five times as much. He felt that he could undertake to build, by the use of his reactance coils, a line having a resistance of four ohms per mile between New York and New Orleans and make it work.

Dr. Pupin's remarks elicited hearty and prolonged applause.

The last paper was that of Professor R. B. Owens, entitled "Notes on Synchronous Converters." The hour being late Professor Owens did not read his paper but satisfied himself with exhibiting a few illustrations showing the effect upon wave form of load and power factor in such machines.

At 4.25 P. M., the Institute adjourned to meet in Paris, August 6, 1900.

The meeting was fairly successful, especially so from the importance of the papers presented, though the attendance was not as large as might have been expected from the central and accessible situation of Philadelphia. At no previous meeting has the Institute received more hospitable treatment, and those who were so fortunate as to be present will remember the occasion as one of great pleasure and profit. The arrangements for entertaining the ladies present at the meeting, including drives, boat excursions and a theatre party, were highly successful and immensely enjoyed.

TELEPHONY OVER CABLES AND LONG-DISTANCE AIR LINES.*

BY DR. M. I PUPIN.

This paper describes a method of constructing cables and long-distance air lines for power transmission by electrical waves, particularly for long-distance telephony and telegraphy. This method is one of the practical applications of the general mathematical theory of wave-propagation over non-uniform conductors, which is given in the second part of the paper. The first part contains a physical explanation of this mathematical theory and a description of experimental researches bearing upon it. It also describes an experimental verification of long-distance cable telephony.

PHYSICAL THEORY OF ELECTRICAL WAVE-PROPAGATION OVER CABLES AND LONG-DISTANCE AIR-LINES.

A. *Wave Propagation Over Uniform Conductors*—Transmission of electrical energy over conducting wires is a *wave transmission* when the distance between the transmitting and the receiving apparatus is sufficiently long to permit the development of electrical waves. Such a transmission exists in long-distance tele-

*Abstract of a paper read at the 17th general meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1900.

graphy and telephony. It does not exist to any practically appreciable extent in ordinary transmissions of electrical power by alternating-currents over distances which up to the present time have been bridged by electrical power transmission lines. In cases of wave transmission considered here the conductors will be called *wave conductors*. The circumstances attending wave transmission are considerably different from those attending ordinary electrical transmission and should be carefully differentiated from them. In ordinary transmission the reactions set up in the receiving apparatus are the most essential reactions which the force impressed by the transmitting generator has to overcome. The reactions set up in the transmitting line itself are small in comparison to it. The case is analogous to the transmission of power from the piston of a steam engine to a motor connected to the engine by a short, stiff, piston rod. The reactions set up in the piston rod itself are small in comparison to the reactions which the motor opposes to the driving pressure. Hence, neither the elastic nor the kinetic reactions of the piston rod, nor the reactions due to internal frictional resistances in the rod are seriously thought of when we analyze the reactions attending this case of power transmission. But consider now what will happen if we increase the distance between the piston and the receiving motor and consequently increase the length of the piston rod. We can no longer consider the rod as a perfectly rigid connection between the driving pressure of the piston and the reactions of the receiving motor. The rate at which the piston delivers energy at any moment is not equal to the rate at which energy is delivered at the receiving motor at that moment. There is a lag in phase. The energy transmitted is first stored up in the piston rod and then delivered from the rod to the receiving motor. While it is stored up in the rod it exists partly as kinetic energy of the moving mass of the rod and partly as potential energy, due to the rod's elastic deformations. The process of transmission consists in successive transformations of the kinetic into the potential energy of the rod and vice versa. These transformations being progressive the energy is propagated along the rod, and we say that the propagation is a wave propagation, in order to state in a single word that the progressive motion along the rod is a periodic one. Analogous conditions exist when electrical energy is transmitted by a periodically varying electromotive force acting on a long conductor. The transmission is not a direct one; it is stored up first in the medium surrounding the transmission line, and from there it is transferred to the receiving apparatus. While it is stored up in the medium it exists there partly as magnetic energy stored up in the field of magnetic flux and partly as electrical energy stored up in the field of electrical flux. The process of propagation consists in the progressive transformation of the magnetic into the electrical energy and vice versa. When the electromotive force impressed by the transmitting generator is a periodic one the propagation will be in the form of electrical waves. The expression "electrical wave" is nothing more nor less than a brief statement of the physical fact that in the case under consideration the energy which at any moment is stored up in the medium surrounding the transmission line is distributed periodically over this line. The current and the potential also vary periodically. At points of maximum magnetic energy the current is maximum, and at points of maximum electrical energy the potential is maximum. Roughly speaking, points of maximum current are points of minimum potential and vice versa.

Wave-length—Consider now the distance between any two consecutive points of minimum current or minimum potential. This distance is a half wave-length. Suppose that the impressed electromotive force is a simple harmonic of frequency 600 periods per second. Say that we find the wave-length to be 18 miles, the velocity of propagation will be 10,800 per second; considerably less than the velocity of propagation of light through a vacuum. To some this numerical illustration may seem as highly improbable, for we are accustomed to hear much of electricity being propagated with the velocity of light. But it should be remembered that this is true under certain particular conditions only. The velocity of propagation of electrical waves of telephonic frequencies over conducting wires may be anything from the velocity of light down to a few inches, or even less than an inch, per second, depending on the inductance, resistance and capacity of the line. The smaller the velocity the shorter, of course, will be the wave-length for a given frequency. *The wave-length*, as will be seen presently, plays a very important part in this investigation.

It is considered here as one of the characteristic constants of wave propagation. I am not aware that previous investigators of the propagation of long electrical waves have devoted any serious attention to this characteristic constant.

Attenuation Constant—There still remains another constant which with the wave-length completely defines electrical wave propagation. It is called here the *attenuation constant*. To bring out its physical meaning consider two consecutive half wave-lengths at any moment. The one nearest to the transmitting apparatus we shall denote by A and the other by B. The wave energy stored up in the medium surrounding A is greater than that stored up in the medium surrounding B. Hence wave energy is gradually dissipated during its propagation from the transmitting to the receiving apparatus, and therefore the amplitude of both current and potential become smaller as the energy progresses along the transmission line. Let U be the amplitude of the current at the transmitting end, and U_2 be the amplitude at a distance s, then if the line be considered infinitely long

$$\frac{U_2}{U} = e^{-\beta s}$$

where e is the base of Naperian logarithms. The constant β is called here the attenuation constant. The mathematical expression for β is well known

$$\beta = \sqrt{\tfrac{1}{2} p C [\sqrt{p^2 L^2 + R^2} - p L]}$$

where L, R, C, are the inductance, resistance, and capacity, respectively, of the wave conductor per unit length, and p is the frequency speed. Much confusion exists in the minds of physicists as to the real significance of this constant, and as to the true cause of current attenuation. It is usually stated that the capacity of the line, acting as it does somewhat like a shunt, is the cause of all the trouble experienced in electrical wave transmission. This statement contains a small part of the truth only, and for that reason may and actually has become misleading. The fact that a conductor possesses inductance and capacity shows that the medium surrounding it is capable of storing up energy, which, indeed, is a blessing; it can not possibly signify that energy propagated along it will be dissipated; and if capacity can not cause a loss of energy, how can it possibly cause an attenuation of current? The dissipation is due to imperfect conductivity of the wire, and to that alone. Inductance and capacity regulate it, they do not cause it. Consider now the manner in which this regulation is effected. The dissipation of the energy transmitted occurs at the time when it is stored up in the medium as magnetic energy; for if the medium surrounding an element ds of the transmission wire contains a quantity dW of magnetic energy, then a current x must flow in that element such that

$$dW = \tfrac{1}{2} L x^2 \, ds$$

Let dH be the rate of dissipation in that element, then

$$dH = R x^2 \, ds$$

Suppose now that by some means we increase L to $n^2 L$, the medium surrounding the elements ds will store up the same amount dW of magnetic energy with one n^{th} of the current, for

$$dW = \tfrac{1}{2} n^2 L (x/n)^2 \, ds$$

Let dH_1 be the rate of dissipation in this case then

$$dH_1 = R (x/n)^2 \, ds = dH/n^2$$

It follows, therefore, that during the transmission of a given quantity of energy over a conducting wire the dissipation will be diminished by increasing the inductance of the wire, for if the wire have high inductance then small currents are required to transmit a given quantity of energy, and small currents incur small ohmic resistance losses.

By increasing the inductance the efficiency of transmission is increased just as effectively as by increasing the conductivity of the transmission wire.

Distortionless Wave Conductors—Another important advantage is gained by increasing the inductance. The expression for β given above shows that attenuation depends on frequency; it increases with it. Hence, in telephonic transmission where waves of complex harmonic frequencies are propagated over the line there will be distortion of the waves, because upper harmonics will be attenuated more vigorously than the lower frequencies This results in a distortion of speech, which is noticed in long-dis-

tance telephonic transmission as defective articulation. Some instructive experiments bearing upon this point will be described presently. High inductance obviates this difficulty. To illustrate—suppose that the inductance is large in comparison to the resistance, the expression for β will reduce to

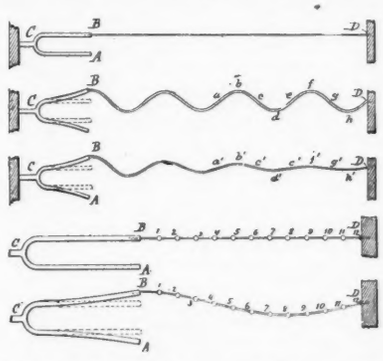
$$\beta = R / 2 \sqrt{C / L}.$$

It is independent of the frequency. All frequencies are attenuated alike, so that high inductance not only diminishes attenuation, but also renders the circuit distortionless. Such a circuit is the ideal circuit for telephonic and telegraphic wave transmission.

Mr. Oliver Heaviside, of England, to whose profound researches we owe most of our mathematical theory of electrical wave propagation, was the originator and most ardent advocate of wave conductors of high inductance. His counsel did not seem to prevail as much as it deserved, certainly not in his own country. I trust that the physical view of attenuation described above in the terms of the dissipation of energy which is transmitted over the wire will help to elucidate Mr. Heaviside's theory of high-inductance wave conductors.

Wave Propagation over Non-Uniform Conductors—But Mr. Heaviside's proposition to employ wave conductors of high inductance contained a serious difficulty which his mathematical theory was not capable of overcoming. The difficulty is this: How can a wave conductor be constructed so as to have a high inductance? Ordinary circuits can be endowed by as much inductance as may be required by simply introducing a coil of proper dimensions, with or without an iron core, into it. But this will never do in the case of a wave conductor; for a coil introduced that way will act by reflection as a barrier to electrical waves. Wave propagation experiments over long-wave conductors containing a certain number of coils in series at periodically recurring points have actually been tried by telephone engineers; the results obtained have invariably proved most disappointing. I shall return to this point later on in connection with the description of experiments given further below. Suffice it to state here that all attempts to increase the inductance of a wave conductor by the introduction of inductance coils at periodically recurring points failed, because they had no mathematical theory to guide them, so as to avoid the difficulties of wave reflection by inductance coils introduced that way. It is hardly worth while to enter here into a discussion of the many other attempts at increasing the inductance of a wave conductor by devices which had neither theory nor experiment to recommend them. In fact, most of them were absurd on the face of it.

The first mathematical theory dealing with wave propagation over conductors of this kind was presented by the author before this Institute on March 22, 1899. The main features of this theory are extremely simple and can be explained by a simple mechanical illustration. Consider the arrangement of Fig. 1. A tuning fork has its handle C rigidly fixed. To one of its prongs is attached a flexible inextensible cord B D. One terminal of the cord is fixed at D. Let the fork vibrate steadily, the vibration being maintained electromagnetically or otherwise. The motion of the cord will be a wave motion. If the frictional resistances opposing the motion of the cord are negligibly small the wave motion will be approximately that of stationary waves as in Fig. 2. The direct waves coming from the tuning fork and the reflected waves coming from the fixed point D will have nearly equal amplitudes, and by their interference form approximately stationary waves. If, however, the frictional resistances are not negligently small, then there will be dissipation of the propagated wave energy. Hence the direct and the reflected waves will not have equal amplitudes, and, therefore, their interference will not result in stationary waves. The attenuation of the wave is represented graphically in Fig. 3. Experiments will show that other things being equal in-



FIGS. 1, 2, 3, 4 AND 5.—WAVE TRANSMISSION ON A LOADED CORD.

creased density of the string will diminish attenuation, because a larger mass requires a smaller velocity in order to store up a given quantity of kinetic energy, and smaller velocity brings with it a smaller frictional loss. This is a striking mechanical illustration of a wave conductor of high inductance. It should be observed here that an increase of the density will shorten the wave-length.

Suppose now that we attach a weight, say a ball of beeswax, at the middle point of the string, in order to increase the vibrating mass. This weight will become a source of reflections and less wave energy will reach the point D than before. The efficiency of transmission will be smaller now than before the weight was attached. Subdivide now the beeswax into three equal parts and place them at three equidistant points along the cord. The efficiency of wave transmission will be better now than it was when all the wax was concentrated at a single point. By subdividing still further the efficiency will be still more improved; but a point is soon reached when further subdivision produces an inappreciable improvement only. This point is reached when the cord thus loaded vibrates very nearly like a uniform cord of the same mass, tension and frictional resistance. Such a loaded cord with a tuning fork attachment is represented in Fig. 4.

If an increase in efficiency of wave transmission over a cord thus loaded is to be obtained, it is evident that the load must be properly subdivided and the fractional parts of the total load must be placed at proper distances apart along the cord, otherwise the detrimental effects due to reflections resulting from the discontinuities thus introduced will more than neutralize the beneficial effects derived from the increased mass.

The problem of finding the proper distance at which the loads should be placed is a definite mathematical problem of Analytical Mechanics, but unfortunately it was never solved. Fig. 5 represents a cord carrying loads at proper distances apart. Experiments with cords of this kind will soon convince one that the distance between the loads should be considerably smaller than one-half of the wave-length of the wave which is to be transmitted. So that though a given cord may be properly loaded for some wave-length it will not be properly loaded for shorter wave-lengths. It is impossible to load a cord in such a way as to make it equivalent to a uniform cord for all wave-lengths; but if the distribution of the loads satisfies the requirements of a given wave-length it will also satisfy them for all longer wave-lengths. It should be observed now that the wave-length which is considered here is not the wave-length of the cord without the loads, but the wave-length which the frequency under consideration will have on the properly loaded cord, or what is the same thing, on a uniform cord of the same mass, tension and frictional resistance as the loaded cord. This point is of fundamental importance, for the wave-length corresponding to a given frequency may, and generally will be, much shorter on the loaded cord than on the cord without the loads.

A cord of this kind is a mechanical analogy to an electrical wave conductor. The mathematical law in accordance with which such a cord moves is the same as that in accordance with which the electrical current is distributed over the wave conductor under the action of similar forces. The reason for that is not far to seek. We have the same reactions in both cases, *viz.:* Kinetic or mass reaction, tensional reaction and resistance reaction in the case of the cord. Electrokinetic reaction, capacity reaction and ohmic resistance in the case of the wave conductor. The mathematical form of these reactions is the same in both cases, hence one is an exact analogy of the other.

The insertion of inductance coils at periodically recurring points along the wave conductor, represented in Fig. 3 of Part II, produces the same effect upon electrical wave transmission as the distribution of the small loads along the stretched cord of Fig. 4 produces upon mechanical wave transmission along the cord. The mathematical theory of wave propagation over non-uniform conductors of this kind is given in Sections I and II of the Second Part of this paper. This theory is, of course, at the same time the mathematical theory of wave propagation over a loaded cord described above. The main object of this theory is find an

answer to the question: *Under what conditions are non-uniform conductors described in these two sections equivalent to their corresponding uniform conductors?* The answer which the mathematical theory gives to the question just proposed is definite. To formulate it introduce here a convenient technical term. Consider the distance between the two consecutive inductance points; that is, the points at which the inductance coils are introduced. Denote it by l, and let the wave length which is to be transmitted be λ. Now introduce an angle φ such that

$$\varphi / 2\pi = l / \lambda.$$

The angle φ shall be called the *angular distance* between the inductance points, or inductance sources. The angular distance 2π corresponds to the wave-length. The law which determines the degree of equivalence between a non-uniform conductor and its corresponding uniform conductor can now be stated as follows: *A non-uniform conductor is as nearly equivalent to its corresponding uniform conductor as sin $\varphi/2$ is to $\varphi/2$.*

It is evident that φ is inversely proportioned to the wave-length, so that for a given distance between the reactance points the degree of equivalence diminishes as the wave-length diminishes. If a wave of complex harmonic frequency, such as occur in telephony, be transmitted over a non-uniform conductor, then the action of the conductor will be different for the different components of this complex harmonic wave. If, however, the non-uniform conductor acts with sufficient approximation as a uniform conductor toward the highest important frequency of this complex wave then its approximation to a uniform conductor will be even higher for the lower frequencies and thus for all the frequencies of the wave. A numerical example will illustrate this point more clearly. It is well, however, to state more fully the meaning of the expression "equivalence between a non-uniform conductor and its corresponding uniform conductor." All that we can predicate of a wave of a given frequency is that it has a certain wave-length and a certain attenuation constant. Hence, if a wave of a given frequency has the same wave-length and the same attenuation constant on a non-uniform conductor as it has on the corresponding uniform conductor then the two conductors are equivalent to each other. If these two quantities differ by, say, three per cent, then an approximate equivalence up to within three per cent exists.

Consider now the following numerical example: A twin conductor, such as employed for telephone cables, has a length of 250 miles. Let its constants have the following values per mile:

Inductance = 0.
Resistance = 9 ohms.
Capacity = .074 microfarads.

According to the high but definite standard which the New York Telephone Company employs, the limiting-distance of telephony over such a cable is 39 miles. According to the lower standard which is maintained in long-distance telephone work the limit would be 78 miles. The results obtained by me experimentally verify these figures. I find that at a distance of 100 miles telephony over such a cable is very poor, in fact, impracticable, and at a distance of 125 miles impossible. It is proposed now to decrease attenuation and distortion over such a cable by the insertion of inductance coils at periodically recurring points. The attenuation constant β in this case is given by the formula

$$\beta = \frac{R}{\sqrt{2}} \sqrt{\frac{C}{L}}.$$

Say that it is required to have $\beta = .015$. Assume that the introduction of the inductance coils adds nine ohms per mile, so that $R = 18$ ohms. These values of R and C require $L = .056$ henrys. The attenuation factor, at a distance of 250 miles, would be $e^{-250\beta} = \frac{1}{50}$, (roughly). That is, two per cent of the current leaving the transmitting end will reach the receiving end. This is quite sufficient for telephonic purposes, but it should be observed that better efficiency of transmission could be obtained by making L larger. The next step is to find the wave-length for the highest important frequency in telephony over a *uniform wave conductor* having $L = .056$ henrys, $R = 18$ ohms, $C = .074$ microfarads. The best telephone practice assumes that 750 periods per second is the highest frequency of any importance. My experiments support this assumption. The wave-length corresponding to this frequency over a *uniform conductor* of this description is obtained from the formula

$$\lambda = \frac{2\mu}{p\sqrt{2LC}} = 14.6 \text{ miles},$$

approximately.

Suppose now that at each mile we place a reactance coil of inductance $L = .056$ henry and a resistance = 9 ohms. The angular distance φ for frequency 750 periods per second of the non-uniform conductor thus obtained will be $2\pi/14.6$. The degree of equivalence of this non-uniform conductor to its corresponding uniform conductor is measured by the degree of equivalence of $\sin \pi/14.6$ and $\pi/14.6$. Now $\sin \pi/14.6$ differs from $\pi/14.6$ by less than one per cent of the value of $\pi/14.6$; hence for a frequency of 750 periods per second the wave-length and the attenuation constant on the non-uniform conductor will differ from the wave-length and attenuation constant on the corresponding uniform conductor by less than one per cent of the values of these constants. Such a difference can not be detected by any of the experimental methods which are at present available for investigating wave propagation. In telephonic transmission the ear could not detect it. For lower frequencies the differences will be even considerably smaller. Hence, the non-uniform conductor thus obtained will represent a non-attenuating, distortionless conductor for telephonic transmission. It should be observed here that in the case of a submarine cable of say 2,000 miles the attenuation constant should be much smaller than the value of β given above, in order to have a sufficiently small attenuation factor. Now the capacity per mile of a submarine cable is about four times as large as the capacity of the telephone cable just described. Hence, both on account of the long distance and also on account of the much increased capacity, the inductance per mile will have to be much larger than in the case just discussed. But high inductance and large capacity will give a very short wave-length. For instance, employing in the case of the submarine cable an inductance six times as large as in the case of the telephone cable we shall obtain for the frequency of 750 periods per second a wave-length of only $14.6 \div 6 = 2.43$ miles. Hence, since the inductance coils will have to be placed apart at one-sixth of the distance employed in the case of the telephone cable, the distance between them will be about 880 feet. The distance between the inductance coils depends entirely on the circumstances of each particular case. But in all cases the rule given above contains the necessary and sufficient directions.

This rule and the method based upon it are recommended by the mathematical theory developed in Part II of this paper for the construction of distortionless wave conductors of high efficiency of transmission. It will be shown now in how far this theory is confirmed by experiment.

(To be concluded)

Automobile Show at Nuremberg.

Mr. Gustave E. C. Weber, United States Consul at Nuremberg, writes as follows:

There will be held in the city of Nuremberg, from June 1 to July 1, 1900, a general automobile exposition. It will not be very large, the ground to be covered having an area of but one acre, and prizes will not be awarded; but it will, nevertheless, be very interesting, in showing what German automobile manufacturers have produced of late.

All kinds of automobiles will be exhibited; *viz.*, private carriages, freight cars, vehicles for transporting prisoners, for sanitary and military purposes, fire brigade, fire engine, motor cars, etc.

The machines will not only be shown in the exposition grounds, but also in the city. Races to the neighboring cities of Würzburg, Kissingen, Bamberg, etc., will take place.

Austria has sent some automobiles to this exposition. France, Belgium and England, renowned for their progress in the automobile industry, could not be induced to take part in it, as they were too much engaged in the forthcoming Paris Exposition.

The most important feature of this exposition will be, undoubtedly, the exhibits of the Schuckert electrical factory, in this city. A large space has been reserved for this firm, where it will exhibit all its latest inventions in motors, etc., for automobiles. As Schuckert is the leading concern in Germany in this branch, I would especially call the attention of our automobile manufacturers to this exposition.

ELECTRIC LIGHTING

The new company which has purchased the gas and electric light plant at Oswego, N. Y., will spend about $90,000 in improvements, it is stated. Details will be announced at an early day.

The new board of directors of the National Electric Company, of Reading, Pa., has elected the following officers: President, H. C. Lucas; vice-president, Paul D. Mills; secretary and treasurer, H. R. Kern.

The Sycamore, Ill., electric light plant has been sold at public auction for the consideration of $12,000. Attorney A. F. Faissler was the highest bidder. It was a forced sale, the company having recently gone into the hands of a receiver.

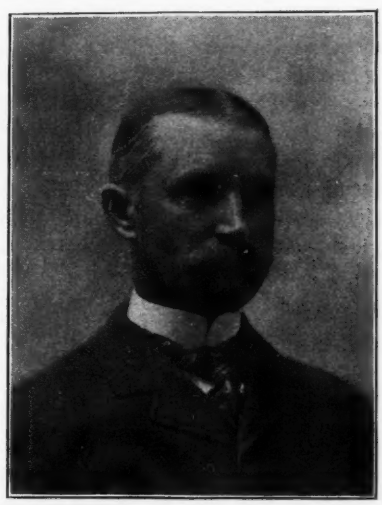
The Indianapolis, Ind., Light and Power Company will put in an immense storage battery in the Lyra-Casino building, which it has just purchased, and this will insure Indianapolis not being left in darkness should something happen to the plant on Kentucky avenue. It will be one of the largest batteries in the United States and its complete cost will be $90,000. The battery will have 156 cells, two and one-half feet wide, and five feet deep, each of which will contain 51 plates and weigh 5,000 pounds. With this battery a uniform voltage will be maintained on the entire system. Should a break-down occur at the power house the battery is of sufficient power to furnish light for the city.

The negotiations for the purchase of the plant of the Catasauqua Electric Light and Power Company, of Allentown, Pa., by the Lehigh & Northampton Gas and Electric Company are completed. The company is incorporated under the law of New Jersey and the officers are: President, M. L. Dreisbach, of Wilkesbarre; vice-president, Liddon Flick, of Wilkesbarre; C. R. Horn, secretary and treasurer. Directors: Mr. Dreisbach, Mr. Flick, Mr. Horn, Mr. Watson, of Scranton, and Mr. Sterling, of Wilkesbarre. The capital stock is $250,000. Ralph S. Weaver will remain as superintendent of both plants. Numerous improvements will be made to both plants and as the company has a franchise for Copley borough, the line may be extended to that place. The gas company was incorporated in 1856 and began business in 1857. Since then it has prospered, and at present has a modern plant. The electric light plant has been in operation since 1890.

Dr. Henry S. Pritchett.

Dr. Henry S. Pritchett, formerly superintendent of the United States Coast and Geodetic Survey, has been elected to the presidency of the Massachusetts Institute of Technology, at Boston.

Dr. Pritchett is only 43 years old and is a young man to occupy a position of such distinction. He was born at Fayette, Mo., his father having been Professor C. W. Pritchett, director of the Morrison Observatory, at Glasgow, Mo. At this school Dr. Pritchett graduated and shortly afterward went to Washington where he continued his mathematical and astronomical studies under Professor Asaph Hall, at the Naval Observatory. Later he went to Munich, where he took his doctor's degree.



DR. HENRY S. PRITCHETT, PRESIDENT MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

His first professional work was as a computer in the Naval Observatory. In 1878 he was promoted to be an assistant astronomer and resigned two years later to take the directorate of the Morrison Observatory. The next year he became professor of mathematics and astronomy in the Washington University of St. Louis, and much of his professional career since then has been in the service of that institution. He occupied the chair of mathematics and astronomy in the university until 1897, when he was appointed chief of the United States Coast and Geodetic Survey. During the intervening time, however, he had frequently been in the service of the government, having accompanied the Transit of Venus Expedition to New Zealand in 1882 and made pendulum observations in Australia, China, Japan and India.

Dr. Pritchett's record as the executive officer of the Survey has been excellent and even brilliant. He has reorganized it and brought it to a high state of efficiency. Those who have enjoyed the privilege of his acquaintance consider that he is admirably equipped and fitted in every particular for his new work.

VIEWS, NEWS AND INTERVIEWS

A few rooms of the imperial court, at Tokio, Japan, are being equipped with electric lights as an experiment.

M. Moissan has been appointed professor of inorganic chemistry in the Paris School of Pharmacology in the place of M. Riche, who has retired.

The Duke of Norfolk, Postmaster-General of England, the head of the telegraph department of Great Britain, has resigned to enter active military service in South Africa. The Marquis of Londonderry has been appointed to the office to succeed the Duke of Norfolk.

A recent press dispatch from Victoria, B. C., states that the Marconi system of wireless telegraphy will soon connect all the islands of the Hawaiian group with Honolulu. Stations have already been established on each of the islands by Mr. H. G. Cross, who is said to be the promoter of the enterprise.

A novel use of the electric light is that made by the Northern Pacific Railroad, which has equipped its locomotives not only with electric headlights, but has placed incandescent lights on the under side of the running boards and beneath the locomotive boiler, thus enabling the engineer and fireman to examine any part of the machinery with ease.

The rumor that the Pennsylvania Railroad Company is negotiating for the Hudson River tunnel from the foot of Thirteenth street, Jersey City, to the foot of Morton street, New York city, occasioned by the purchase of the Long Island Railroad by the Pennsylvania, has brought to light negotiations which have been pending for some time, and which will probably result in the running of trolley cars from New York to Jersey City and thence to all parts of New Jersey.

A Chicago press dispatch states that the South Chicago Street Railway Company has introduced into its cars whiskbrooms and clothes brushes. These useful articles are placed in a small cabinet in the forward end of the car within easy reach of the passengers, with an announcement beneath notifying travelers that the brushes are at their disposal. When it is necessary for a dusty passenger to use the brushes he is asked to step to the rear platform. When he has concluded the brushes are to be placed in the cabinet.

THE INDEPENDENT TELEPHONE ASSOCIATION.

DETAILS OF THE FOURTH ANNUAL MEETING

The fourth annual meeting of the Independent Telephone Association of the United States, to be held at Cleveland, Ohio, June 12, 13 and 14, promises to be a very large gathering. President James M. Thomas states that there never has been so much interest shown in the convention, in all parts of the country, as indicated by correspondence, and the meeting is still nearly a month away.

An exhibition by the manufacturers of the telephone field will be held on the second floor of the Electric Building, and promises to be quite large and interesting. The space is being taken rapidly. Mr. C. W. Wason, chairman of the entertainment committee, is in charge of the exhibit, and is making his headquarters at the Electric Building, Cleveland, Ohio.

The following gentlemen have been appointed a committee on entertainment:

C. W. Wason, Chairman.
D. J. Kurtz, Wm. Binghan Company.
A. M. Barnes, Miller Chemical Engine Company.
J. E. Ebersole, Geo. Worthington Company.
Wm. Smith, W. M. Pattison Supply Company.
W. E. Davis, National Carbon Company.
H. W. Jones, Electrical Supply and Manufacturing Company.
A. B. Foster, Electric Supply and Construction Company.
G. C. Steele, North Electric Company.
H. W. Avery, Avery Stamping and Tool Company.
L. Sands, Williams-Abbot Electric Company.
W. P. Bowman, John A. Roebling's Sons Company.
H. T. Pratt, American Steel and Wire Company.
C. S. Powell, Westinghouse Electric and Manufacturing Company.
S. R. Driffield, Consumers' Rubber Company.
W. A. Foss, American Toll Telephone Company.
Carl Seyler, McIntosh Huntington Company.

An excellent programme of addresses and discussions is being arranged, and it is safe to predict that this convention of the Independent Telephone Association will prove the most important and interesting that has been held.

The officers of the association are the following named gentlemen:

James M. Thomas, president, Chillicothe, Ohio.
Charles Flowers, first vice-president, Detroit, Mich.
I. A. Lumpkin, second vice-president, Mattoon, Ill.
Geo. T. Hedges, third vice-president, Cedar Rapids, Iowa.
S. P. Sheerin, secretary and treasurer, Indianapolis, Ind.
Geo. W. Beers, first assistant secretary, New York, N. Y.
Samuel E. Wayland, second assistant secretary, Wilkesbarre, Pa.

Advisory Board: James M. Thomas, Chillicothe, Ohio; S. P. Sheerin, Indianapolis, Ind.; Hugh Dougherty, Bluffton, Ind.; H. D. Critchfield, Mt. Vernon, Ohio; E. B. Fisher, Grand Rapids, Mich.; Thomas W. Sennott, Chicago, Ill.; H. C. Young, Columbia, Pa.; W. B. Seaton, Ashland, Ky.; W. H. Durin, Cedar Rapids, Ia.

International Association of Municipal Electricians.

The Executive Committee of the International Association of Municipal Electricians held a meeting at the Clarendon Hotel, Brooklyn, N. Y., May 17, at 10 A. M. The meeting was presided over by Captain William Brophy, president of the association, and the following officers and members of the executive committee were present:

William Brophy, G. F. MacDonald, Adam Bosch, Burt C. McAllister, Morris W. Mead, W. Y. Ellett, J. W. Aydon, F. G. Boyd and F. C. Mason. In the absence of the secretary, Mr. F. G. Boyd, of Baltimore, was named as secretary *pro tem.* The minutes of the last meeting of the executive committee were read and approved. It was then by motion decided that four topics should be selected for discussion at the next meeting at Pittsburgh, Pa., September 25, 26 and 27. Accordingly the following topics were selected and assigned: "Benefits to be Derived from our Association," assigned to Captain William Brophy, of Boston. "Contact Points," assigned to Frank C. Mason, superintendent of Brooklyn Police Telegraph. "Trials and Troubles of Instituting and Enforcing Municipal Inspection and Control," assigned to M. G. Canfield, of Grand Rapids, Mich. "Automatic Fire Alarm Systems," assigned to Charles Burger, of Boston.

It was decided that there shall be two sessions daily, the morning session to begin at 9.30 and terminate at 1 P. M., the afternoon session from 2.30 to 5.30 o'clock. Immediately upon roll call, which shall be the first order of business upon convening, all members not answering the roll call shall be recorded as being absent unless reasonable excuse be given by such members to the presiding officer.

Upon motion it was decided that the printing and distribution of the reports of the Pittsburgh Convention be left in the hands of Mr. M. W. Mead.

The report of ex-President J. W. Aydon, of Wilmington, Del., was received and approved.

TELEPHONE AND TELEGRAPH

A press despatch from Philadelphia states that there is a doubt as to whether the franchise recently granted to the Keystone Telephone Company will ever be more than a franchise, or like most of its predecessors, "expire by limitation," or become the basis for a practical opposition company. The general feeling, however, is stated to be that the ultimate fate of the franchise will probably be more or less influenced by the Telephone, Telegraph and Cable Company of America.

The Michigan Telephone Company has recently completed the construction of new lines connecting lower Michigan with the Upper Peninsula. The new line runs from Grand Rapids through Traverse City and Petoskey to Mackinaw City, thence by cable across the straits of Mackinac to St. Ignace, and thence to Marquette and other towns in the iron mining district. Another line runs from Marquette and Negaunee southward to Escanaba and Marinette, Wis., connecting at that point with the lines of the Wisconsin Telephone Company to Milwaukee. No. 8 copper circuits have been strung on both routes to furnish through service for the longer hauls, the balance of the circuits being No. 12 gauge. From Powers, Mich., a line has been built to Iron Mountain and other stations, opening up for telephone service all the mining towns in the Menominee range. The new lines have been opened for traffic. On May 9, informal exercises were held at Marquette by way of inaugurating the service and a large number of invited guests had an opportunity to talk with subscribers in Chicago, Milwaukee, Detroit, Grand Rapids and many other stations. The service was excellent and the residents of Marquette were highly pleased with the working of the new lines. In the evening music was received over the wires from the Schlitz Palm Garden, at Milwaukee. On the 10th, 11th and 12th instant openings were held at Ishpeming, Iron Mountain and Escanaba, respectively, informal talks being held with numerous cities throughout the country. In each case the music furnished from the Palm Garden was an entertaining feature of the program. The new lines open up in the telephone world the remarkable iron districts of the Upper Peninsula of Michigan. The Michigan Telephone Company will within a month complete its new line from Marquette to Houghton and Calumet, which will open up the rich copper district of Michigan. Another new line is being built to furnish connection with Sault Ste Marie.

A Complete Series Alternating Enclosed Arc System.

The best solution that has yet been obtained of the interesting and important problem of arc lighting distribution from large, direct-coupled units has been reached in the perfection of series alternating-current systems employing automatic current regulators and enclosed lamps. The illustrations herewith show some details of the Manhattan General Construction Company's system as manufactured at its factory in Newark, N. J.

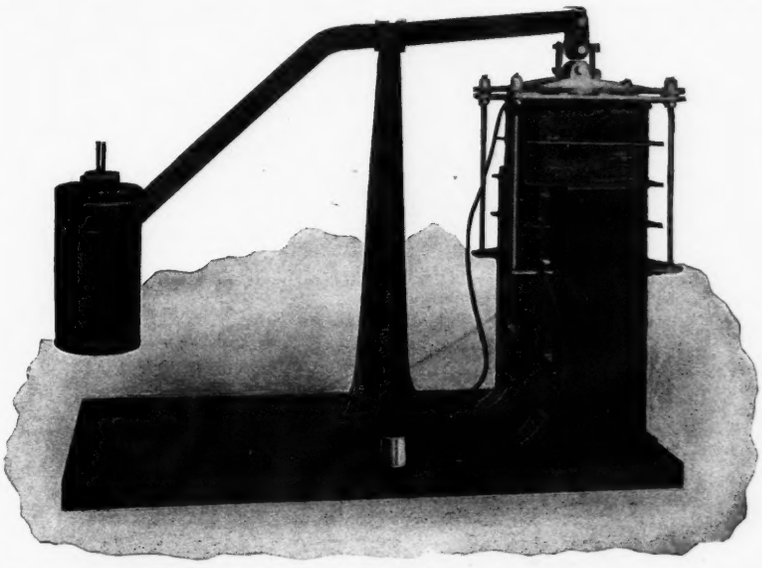
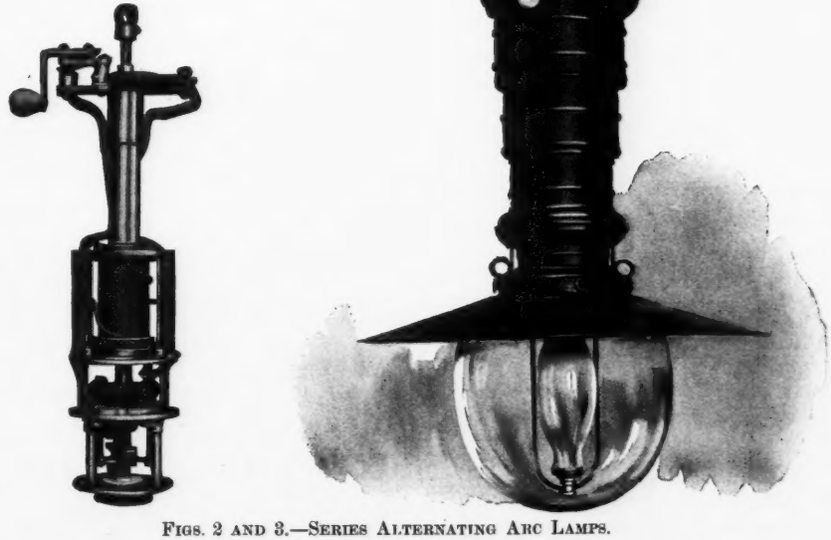


FIG. 1.—REGULATING TRANSFORMER FOR SERIES ALTERNATING-CURRENT ARC LIGHTING

The regulator which is shown in Fig. 1 is of the general type employing an open magnetic circuit transformer and an automatic regulating coil in series with the lamps. This coil is mounted at the end of a scale-beam lever, as is well shown in the illustration. As will be seen, the moving parts are reduced to a minimum, the apparatus being exceedingly simple. It is claimed by the makers that its regulation is correct to within one-tenth ampere on the ordinary arc circuit between full load and dead short-circuit. The current used in the series connected with the regulator may be changed to any power by changing movable weights on the regulator arm.

The arc lamps employed are shown complete and in detail in Figs. 2 and 3. They are of the concentric shunt type employing only one magnet and have no springs of any kind in them. There is only one moving part which is the central tube carrying the armature which passes freely through the magnet coil. It is claimed that the only energy loss in the lamp when running is that due to a current of 0.4 ampere flowing in the shunt coil which is made of No. 23 wire. The manufacturers claim the loss to be five watts per lamp. No resistance is employed in the lamp and a simple and satisfactory cutout is used in connection with it. One great advantage of the series system is that grounding does no damage. The efficiency of the lamps is claimed to be 99 per cent, and their power factor .91. In the complete circuit containing lamps and regulator, the power factor is said to have been measured at .88. The system has been ingeniously and thoroughly worked out with great completeness by the manufacturers and is said to have given excellent satisfaction wherever used.



FIGS. 2 AND 3.—SERIES ALTERNATING ARC LAMPS.

The annual meeting of stockholders of the Erie Telegraph and Telephone Company will be held at New York city on June 12. The question of increasing the number of directors from 12 to 25 will be considered and acted upon.

PARIS EXPOSITION NOTES

A sinking in the Grand Palace on the Champs Elysees caused the fall of two marble statues. Both were badly broken.

A press cable despatch, dated May 15, says that fire in the Chateau d'Eau, at the exposition, has destroyed the entire electric apparatus for the illumination of the fountains.

A reader of the ELECTRICAL REVIEW, who arrived in New York city from Paris last Saturday, reports that it is the general opinion in that city that the exposition can not possibly be completed before July 1.

A press cablegram, dated Paris, May 8, states that a storm has seriously damaged the United States section of the electricity exhibit at the exposition. Water poured through the leaky roof, ruining the decorations and carpets and damaging the facade. The water badly warped it and all work there has been stopped until the extent of the damage to the wiring is ascertained.

The discovery of an attempt to cause an explosion compelled the postponement of Sunday's Fête de Nuit at the exposition, on May 6. Engineer Germain, of the staff of electricians, whose dynamos were installed in the Champ-de-Mars, informed the police that malefactors had placed a handful of gravel in the lubricating box of a 1,500 horse-power electrical generating engine. This engine furnished the lighting for the main entrance to the exposition.

SCIENCE BREVITIES

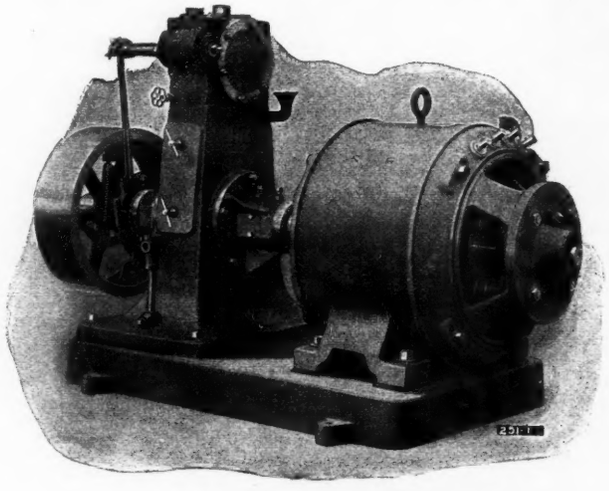
Errors in Magnetic Instruments—While determining index corrections of the compass declinometers belonging to the United States Coast and Geodetic Survey, Mr. G. R. Putnam observed motions of the magnetic needles of such a nature as to leave no doubt that the glass covers of these instruments carried strong electrostatic charges, caused by atmospheric conditions, which at the time were especially favorable, the weather being dry and cold. In two of the declinometers, in which the glass covers were replaced by brass plates, with only small pieces of glass covering the openings through which to observe the points of the needles, no erratic movements were noticed, and repeated determinations of their index corrections agreed with each other within the error of observation; while before, nearly all observers using these instruments reported occasional discrepancies in their results which could not be accounted for. In reporting upon this source of error, Mr. E. G. Fischer, writing in *Terrestrial Magnetism,* raises the question as what may be the effect of the same phenomenon upon magnetic needles in other instruments. The theodolite magnetometers do not seem to be sensibly affected, but in the dip-circle, the manner of housing the magnet is such as to immediately raise the question whether the frequent want of accord between the results obtained may not be due to electrostatic disturbance. As a remedy, both sides of the magnet case should be of brass, and should be so arranged that they can be rotated about the axis of the needle, in order to bring the openings opposite the points. In any case, wherever glass must be used in magnetic instruments, it should contain a large percentage of lead.

Actinium—By treating pitch blende with the reagents used for the extraction of metals of the iron group, and more especially of titanium and thorium, M. A. Debierne has succeeded in discovering a new radio-active substance, which has the general characteristics of thorium, but does not follow that metal through all its reactions. If a barium or bismuth salt is added to a solution of the new substance, the salt added may be eliminated by means of ammonia or sulphuretted hydrogen, without thereby eliminating the radio-activity. This proves that the latter is not due to either radium or polonium. The author calls the new substance "actinium." It produces the same phenomena of fluorescence, photographic action, and ionization, as radium and polonium, says one of Mr. Fournier d'Albe's abstracts. All the experiments of magnetic deflection made by Giesel, Meyer, Schweidler and Becquerel may be repeated with actinium. It also produces, to a slight extent, the permanent induced radio-activity described by Curie. It is known that the salts of thorium are feebly radio-active. The author suggests that their radio-activity may be due to traces of actinium, and that the latter is, in fact, the active principle of thorium radiation.

Magnetized Coherers—In the course of some experiments in wireless telegraphy made between Brest and Ouessant, M. C. Tissot hit upon a device which considerably increased the sensitiveness of the nickel or steel coherer used, and at the same time made it work with greater regularity and certainty. To quote the *Electrician,* the device consists in placing the coherer in a magnetic field whose lines of force are parallel to the axis of the tube. The latter should contain some kind of magnetic filings, steel, nickel or cobalt. The electrodes should preferably be non-magnetic, and the tube may be placed between the pole-pieces of an electromagnet feebly excited. The first result observed is that the terminals may be drawn very much further apart without annulling the action. The distance may, in fact, be increased from one millimetre to six millimetres. Both the current traversing the coherer and the magnetic field controlling it should be feeble, as otherwise the decohering action is interfered with. One of the most striking results was the exchange of signals with the warship "Massena," over a distance of 18 nautical miles, with signaling masts only 100 feet high. The action of the magnetic field appears to be purely mechanical. It is important on account of the ease of regulation which it introduces, even in the case of sealed tubes, whose sensitiveness can easily be brought to the point required. When the field is suddenly withdrawn, a very slight shock suffices to decohere the apparatus. This suggests the possibility of working the magnet by a relay, and thus securing automatic decoherence.

Marine Electric Lighting and Power Units.

There is no situation requiring greater perfection of design and workmanship for the satisfactory installation of electrical apparatus than aboard ship. This is especially true when electric lighting or power units have to be installed aboard yachts and small craft of various kinds. Weight, space, freedom from vibration, durability and economical operation are all important factors. The illustration shows a direct-coupled unit which is manufactured by the Bullock Electric Manufacturing Company, of Cincinnati, and



A Marine Generating Set.

of which a large number are in use aboard yachts and small vessels. It consists of a four-pole, cylindrical-type, internal-pole, Bullock generator, mounted on the base with and direct-coupled to a Case automatic high-speed engine. The apparatus is so well illustrated in the engraving herewith that it is hardly necessary to enter into further particulars regarding it. The construction of both engine and dynamo is along the lines of the best engineering.

Electrically Heated Soldering Irons.

L'Eclairage Electrique recently contained an article describing the various types of electrically heated soldering irons and plate for soldering tin canisters, etc., hitherto in vogue. Most of these devices obtain their heat from resistances embedded in some insulating material, such as porcelain, but the Allgemeine Elektricitäts-Gesellschaft have introduced a soldering iron which is heated in a novel manner by means of an electric arc in an enclosed cylinder. The same firm have applied the principle to a number of different heating devices, including flat irons.

The method was patented some years ago by Rudolf Wieczoreck. In its application to a soldering iron a cylinder of wood is employed, which carries the soldering iron at one end, while at the opposite end a carbon receptacle is attached. The arc is formed between the carbon and the copper of the iron, the consumption of carbon being small in consequence of its being enclosed. When the iron is not in use the copper is moved back away from the carbon. To form the arc an eccentric is turned, by which means the carbon is brought in contact with the copper, a further slight turn of the eccentric separating the carbon from the copper again and so forming the arc. From four to five amperes of current at a pressure of from 25 to 35 volts are consumed by such a soldering iron, according to the length of the arc. We are not told how long the copper stands the treatment, says the London *Electrical Engineer,* from which the above is extracted.

Standard Types of Ceiling and Desk Fans.

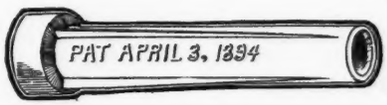
The electric fan of to-day has been improved and worked upon to such a point that it has reached in its own class practically the same efficiency and satisfactoriness of operation as the larger machines have achieved in their particular spheres of operation. The illustrations shown herewith represent somewhat familiar varieties of ceiling and desk fans which are manufactured by Messrs. D. L. Bates & Brother, of Dayton, Ohio. The particular merit of these fans is claimed by the manufacturers to reside in the great care given their mechanical construction. They are manufactured in a large number of styles, such as ceiling, column, desk, wall and bracket types, with or without switches and chandelier attachments, and are wound for any voltage of direct-current up to and including 500 volts. The finish of these fans is in nickel, oxidized copper, polished brass or japan, as desired.

FIGS. 1 AND 2.—STANDARD TYPES OF DESK AND CEILING FANS.

An interesting specialty manufactured by the same firm is direct-coupled fan-driving water motors of small size, intended to be used for desk or bracket fans, but operated by water, and useful, of course, only in situations where there is water supply but no electric supply.

A Wiring Tube Novelty.

There hardly seems room for much invention in wiring tubes, which are simply porcelain tubes adapted to go through holes in woodwork when conducting wires have to be led through partitions, for example. Nevertheless, an interesting new type has been brought out, possessing some remarkable advantages, and at the same time great simplicity. It is well shown in the accompanying illustration. Instead of the plain tube with a flange on the end to keep it from slipping through the hole, this tube is provided with "fins," having sharp edges. When it is put in place in a hole in woodwork it stays there. The ordinary tube has a habit of falling out unless the hole is slanted so as to keep it in. Often when wire is put in through several of these old-style tubes they come out of their holes and appear like beads strung on the wire. The new tube is stated by its maker, the Pettingell-Andrews Company, of Boston, to be made of a very high-grade of porcelain and to have given great satisfaction in use.



A WIRING TUBE NOVELTY.

A Coal Mine Trolley Road.

The Saginaw Southern Electric Railroad, which is to be constructed from Detroit, Mich., to St. Charles, Chesaning, and Durand, will touch about a dozen coal mines with as many more projected, and it is the intention of the railroad company to haul coal over the road. For this purpose coal yards will be established. Freight will be hauled over the line nights. The road will touch the Grand Trunk system, Michigan Central and Pere Marquette systems.

The New York State Railroad Commission has granted the application of the Third Avenue Railroad Company, of New York city, for approval of the issue of a first consolidated mortgage for $50,000,000.

ELECTRIC RAILWAYS

The Waterville & Fairfield, Ct., Railroad and Light Company is making some extensive improvements about the power station in Fairfield. Something like $50,000 will be expended.

At the annual meeting of the Saginaw Valley Traction Company, of Saginaw, Mich., the following directors of the company were chosen: T. A. Harvey, G. M. Stark, George B. Morley and Charles A. Smith, Saginaw; C. Sidney Shepard, New Haven, Ct.; and Henry E. Cobb and Homer Loring, of Boston.

The Conestoga Traction Company, at Lancaster, Pa., has elected the following directors: William B. Given, Columbia; Samuel K. Shipley, J. Robert Foulk, William B. Kurtz, Philadelphia; John D. Skiles, Eugene G. Smith and J. W. B. Bausman, Lancaster. Oscar M. Hoffman, of Columbia, was elected treasurer.

The Milford, Hopkinton & Westboro, Mass., Street Railway Company, which will soon be merged with the Milford, Attleboro & Woonsocket, the stockholders being identical, has levied an assessment of 10 per cent upon its capital stock of $80,000. It is the intention of the company to rush this line through to completion this Summer, and to have cars running by September 1.

President McNary, of the Logansport, Ind., Rochester & Northern Traction Company has recorded a $4,000,000-mortgage in favor of the Mercantile Trust Company, of New York, which corporation furnishes the money to build and equip the electric line from Logansport to Kendallville. The mortgage will be recorded in Cass, Fulton, Kosciusko and Noble counties. The bonds will be in Mr. McNary's hands soon, and construction will be commenced in June.

The Lock Haven, Pa., Traction Railway, which was recently sold at receiver's sale, has passed into temporary control of the Susquehanna Traction Company. The president is William B. Given; secretary, H. W. Daron; treasurer, H. B. Rhodes, all of Columbia. They, with C. A. Bragg and W. D. Marks, of Philadelphia, and General Manager Frank Andes, of Lock Haven, are the directors. The capital stock is $200,000. Bonds to the amount of $100,000 will be issued, $75,000 of which will be expended on the old debt and for repairs. On June 1, A. N. Chandler & Company, of Philadelphia, will take charge of the road, which extends from Lock Haven to Millhall.

AUTOMOBILES

The Brooklyn Rapid Transit Company, of Brooklyn, N. Y., has recently completed satisfactory tests of electromobiles for its repair wagon service.

The automobiles which took part in the 1,000-mile trial from London to Edinburgh and return, reached London on May 12. The tour was a great success.

Mention has been made of the fact that the public electromobiles in Paris are working under very disadvantageous conditions of service. The batteries of the vehicles are recharged at a station so far from the centre of Paris that the cabs have to run for about half an hour on dead mileage before they can take up any fares. It is stated that about 50 of these cabs are now in commission.

The Washington Electric Vehicle Transportation Company has just issued a remarkably tasteful and well prepared booklet describing its public electromobile service in Washington. Illustrations of the company's central station, the various types of vehicles it has for hire and full details of its business for the information of the public are given in convenient and handy form. In fact, the booklet is one that safely may be taken as a model by other companies in a similar line of business.

A new automobile company, with $300,000 capital, has been formed to operate a public automobile service in Boston. The company will be known as the Boston Woods Motor Vehicle Company. Among the officers and directors are several prominent gentlemen, including General William A. Bancroft, president of the Boston Elevated Railroad. The company will conduct a selling business and a delivery service in addition to the public automobile service. A central station will be established on Eliot street, between Washington and Tremont streets.

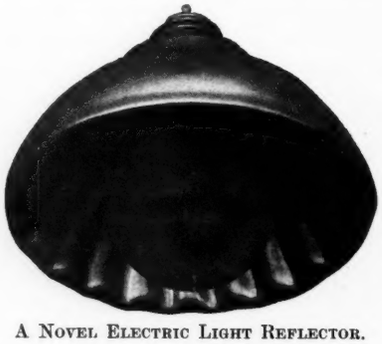
A press dispatch from Lyons, N. Y., states that President Orlando F. Thomas, of the Empire State Sugar Company, who is erecting a $600,000 beet sugar plant at Lyons, has given an order to the General Carriage Company, of New York, for 10 automobiles, five tons capacity each, to be used to cart sugar beets from farms to the refinery. The company has 5,500 acres contracted for. Mr. Thomas has also given an order to the same company for three electric omnibuses to run between Lyons and Sodus Point, on Lake Ontario, a Summer resort, to compete with the Northern Central Railroad for passenger traffic.

Electrical Catalogues Wanted in Cuba.

Mr. R. Adelsperger has been appointed supervising architect of the Department of Charities and Hospitals for Cuba, with offices in Havana. Mr. Adelsperger informs the ELECTRICAL REVIEW that many extensive building operations of the most varied character are under way and in contemplation. He will be glad to receive catalogues, price lists and samples from the electrical industry for such material as may be used in his work. Domestic postage will be sufficient on anything mailed to his address.

A Novel Electric Light Reflector.

The illustration herewith shows a novel incandescent lamp reflector imported from Germany by Schiff, Jordan & Company, 232-34 Greenwich street, New York. The reflector is of plate glass, silvered, and gives a most intense light. In fact, it is



A NOVEL ELECTRIC LIGHT REFLECTOR.

claimed that an ordinary 16 candle-power lamp is made to reflect 64 candle-power of light by the use of this device. These reflectors are made in various designs and sizes and the incandescent lamps are specially manufactured to conform to the contour of the reflector. The lamps are furnished dipped in any color and by using colored lamps most attractive effects may be accomplished with this reflector for show windows, stores and advertising purposes. They are also desirable for offices and study work.

PERSONAL.

Mr. James F. Cummings, of the American Vitrified Conduit Company, New York city, sailed for Europe last week.

Mr. Charles McLaughlin, head of the house of J. H. Bunnell & Company, New York city, returned recently from a visit to Mexico.

Mr. Samuel M. Hamill has been elected president of the Siemens & Halske Electric Company of America, of Chicago, which was recently acquired by the General Electric Company. Mr. Hamill is well-known in the electrical industry and for many years has been connected with the Brush Electric Company and the General Electric Company.

Compensators for Alternating-Current Circuits.

A complex problem to be considered in the transmission of electric energy is the maintenance of a proper and constant electromotive force at the point of consumption. The drop of potential between the generating station and the point of consumption varies according to the size and length of the conductor, and the amount and nature of the load. With a single circuit the regulation is simple, being effected by adjusting the voltage of the generator. But if the same generator supplies current to several different circuits, upon which different and varying conditions exist, it is necessary to regulate the voltage of each circuit independently. Where the load varies over a wide range, it may be advantageous to admit a considerable drop during the limited time the full load is supplied, in order that the first cost of the transmission line may be reduced, but in such case it becomes necessary to supply at the power station a voltage considerably higher than that required at the load. In other circuits where full load is carried most of the time, it will be more economical to install a conductor of large current-carrying capacity, so that the percentage of drop in voltage may be kept within limits. In many cases the cost of transmission circuits may be considerably reduced if suitable devices are installed at the power station for regulating the voltage at the point of consumption.

To accomplish this result and enable the attendant to regulate the voltage properly, means must be provided at the power station for indicating the electromotive force at the point of consumption. The old method was to run pressure wires from the end of the circuit back to the power station, these wires being large enough to carry sufficient current for the voltmeter without an appreciable loss. This was expensive and resulted in a great deal of complication, and became prohibitive when feeders covered the great distances which are now common in lighting and transmission plants.

What is claimed to be a simple, inexpensive and thoroughly effective method of attaining the same result is by the use of the compensator, an instrument used in connection with the station voltmeter by which it indicates the voltage at the point of consumption, instead of the voltage at the power station. The compensator is made in two types by the Westinghouse Electric and Manufacturing Company; type E compensates for ohmic drop only, while type F compensates for both ohmic and inductive drop.

The type E compensator, shown in Fig. 1, is used in connection with the station voltmeter on circuits in which there is an appreciable drop due to ohmic resistance. It enables the attendant to adjust the potential at the station so that the candle-power of the lamps on the circuit remains

constant, notwithstanding variations in the load with the consequent loss or drop in the line. The compensator acts on the voltmeter in such a way that the pressure on the circuit must be increased as the load grows heavier, in order that the voltmeter may give its normal indication. An ordinary voltmeter connected to the feeder circuit at the station switchboard will be subject to a variation of about ten per cent if the potential in the circuit be properly adjusted from time to time to meet the requirements of lamps. When a compensator is used, it is only necessary for the switchboard attendant to see that the index of the voltmeter indicates the voltage required at the point of consumption under all conditions of load. This is accomplished by adjustment of the generator field rheostat or of the potential regulator, and if the compensator is properly adjusted the lamps connected to the circuit will be continuously supplied with current of the required potential.

The compensator is a transformer, the primary of which is connected in series with the supply circuit. The number of turns of the primary and of the secondary

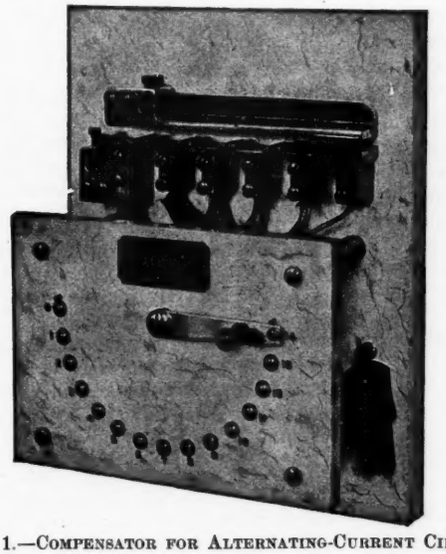


FIG. 1.—COMPENSATOR FOR ALTERNATING-CURRENT CIRCUITS.

is adjustable, the latter being connected with the voltmeter. As the load on the circuit increases, current through the primary increases, which sets up a corresponding action of the secondary current. In some types of compensators the secondary is connected in series with the voltmeter circuit. The secondary of the type E compensator is connected to an auxiliary coil wound round the voltmeter solenoid. The action is similar to that of the series coil on a compound wound generator. The current from the compensator is opposed to the current in the solenoid, and as the action of the auxiliary coil increases, the current through the main solenoid must be increased in order to give the same resultant pull on the core. This requires a higher pressure on the voltmeter itself, and consequently an increased pressure on the circuit. The amount of compensation depends upon the number of turns in the auxiliary coils.

If an ordinary voltmeter be used, the attendant must at frequent intervals compare the voltmeter with the current as indicated by the ammeter, and adjust the potential registered by the former to a voltage which calculation has shown is required by the current in the circuit. Experience has shown that such a method leaves too much to the judgment and attention of the switchboard attendant, and in central station work it is preferable that the voltmeter indicate the voltage at the point of consumption, rather than at the station. This result is accomplished by the use of a Westinghouse compensator. In a 100-volt circuit in which the drop is 10 per cent when the load is 20 amperes, the station pressure should be increased 10 per cent in order that the pressure at the lamps may remain normal. The compensator is set so that the voltmeter reading is reduced 10 per cent when the current is 20 amperes, and 110 volts is then required to give an indication of 100 volts on the voltmeter. When there is no load upon the circuit the compensator is inoperative, and the voltmeter is properly deflected by 100 volts. As the current to a circuit increases, the action of the compensator also increases, and the pressure must be raised in order to give the normal deflection in the voltmeter. Westinghouse type E compensators are arranged for a capacity up to 160 amperes, and for alternations varying from 7,200 up to 16,000.

The instrument illustrated in Fig. 2 is set to allow for the ohmic and inductive resistance of the circuit in which it is used. To secure a constant electromotive force of the load, it is necessary to provide such a voltage at the station that the voltmeter under the influence of the compensator, will give the same indication as it does at no load, whatever may be the current, power factor, reactance and resistance. It is well known that the drop in a direct-current circuit is dependent upon the resistance, but in an alternating-current circuit it is due not only to the resistance of the lines but also to the inductance. The inductance of the circuit usually causes the drop to be greater than if the resistance were the only factor. The drop in an alternating-current circuit depends not only on the current flowing, but also on the character of the load. For instance, the drop in voltage caused by current to arc lamps is usually greater than that produced by an equal current to incandescent lamps; and the current supplied to fan motors and to induction motors also produces a greater drop than an equivalent current to incandescent lamps.

The type F compensator is designed to give accurately the voltage of the load at all times, whatever may be the current or the character of the load. It is moreover capable of adjustment for circuits which differ in ohmic loss and in inductance. It has two adjustments, one for the ohmic resistance, and the other for the inductance of the transmission circuit. The general principle of operation is similar to that of the type E compensator which

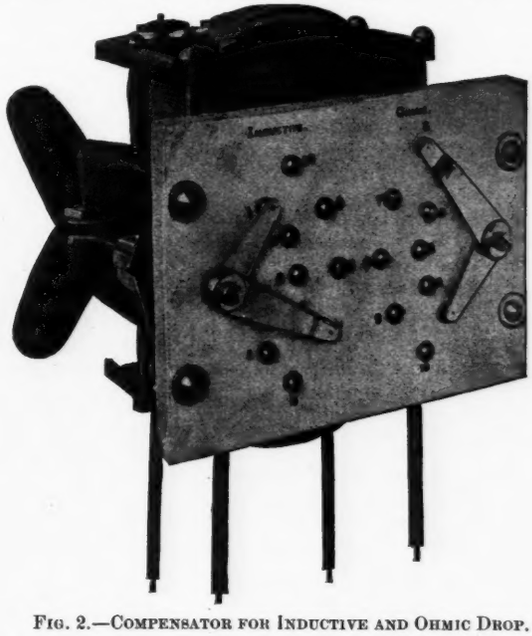


FIG. 2.—COMPENSATOR FOR INDUCTIVE AND OHMIC DROP.

has been fully explained above. The type F compensator is specially designed for use on circuits supplying power for motors, where it is desired to regulate the voltage at the point of load from the central station.

The compensator used for single-phase, and for one phase of two-phase circuits, is connected by means of a single series transformer. For a balanced two-phase circuit, one compensator connected in one of the phases is sufficient, but if the two phases are unbalanced, a compensator should be used in each. In three-phase circuits, the compensator used for one-phase of three-phase circuits is connected by means of two series transformers, but if the three phases are balanced, one compensator is sufficient. The type F compensators are arranged for current varying from 20 to 200 amperes, and for compensation from six per cent to 36 per cent, and for alternations from 3,000 to 7,200 cycles per minute.

INDUSTRIAL NOTES

The repair shops of the Chicago Edison Company, 76 Market street, Chicago, are open day and night for all electrical work.

The Michigan Electric Company, the electrical supply house at Detroit, Mich., is carrying in stock the Stanley & Patterson cigar lighters.

The Lea Electric Manufacturing Company, Elwood, Ind., will send on request a copy of a most attractive catalogue of the Lea arc lamps to those inquiring.

Many large consumers throughout the United States, Canada and Mexico are using the "Crown" woven wire dynamo brushes made by the Crown Woven Wire Brush Company, Salem, Mass.

The American District Steam Company, Lockport, N. Y., will send a copy of its catalogue to those mailing request, describing its system of exhaust steam heating.

The "Continental" 100-volt arc lamp is claimed by the manufacturers, the Continental Electric Company, Boston, to show a gain in light of 40 per cent over all other lamps.

The Electric Appliance Company, Chicago, state in an answer to inquiries that at the present time the Gutmann wattmeter is only made for alternating-current systems.

David Cronin, supply dealer, Syracuse, N. Y., has bought the patent rights and name of the Cherry-Younglove dynamo brush and will hereafter manufacture it for general sale.

The Bromley Battery and Manufacturing Company, Painesville, Ohio, state that they make and market the only real "Bromley" soldering paste and that all others are infringements.

Macferran & Heywood, 3314 Haverford street, Philadelphia, Pa., are introducing a patent adjustable manhole cable hanger, and will send a descriptive catalogue to those inquiring.

The Geo. C. Towle Manufacturing Company, Lancaster, Pa., make a line of desk, ceiling and bracket fans for direct-current application. This company has issued a new catalogue for the season.

The Westinghouse Electric and Manufacturing Company's branch office heretofore located in Tacoma, Wash., has been moved to Seattle, Wash., where it is situated in the Snoqualmie Building.

The Potomac Terra Cotta Company, Washington, D. C., will be glad to send descriptive literature relative to the Mason terra cotta conduits, for underground work, of which it is the sole maker.

The Williams Electric Company, Cleveland, Ohio, according to its assignee's statement is having a large degree of prosperity, and its shops are now working under an impetus of substantial orders for telephone parts and assembled telephones.

The Montauk Multiphase Cable Company has just published a booklet of unusual beauty describing the valuable properties of its fire detective cable and wire. This book may be had on application at the company's office, 100 Broadway, New York.

The Emerson Electric Manufacturing Company, St. Louis, Mo., has adopted a system of sending weekly notices to its customers in the east as to the exact number and types of fan motors carried in stock at the moment in the New York office.

The Phoenix Glass Company, New York city, have now ready for distribution the new catalogue of electric and gas globes, shades, etc. A request sent to either their office in New York, Chicago or Pittsburgh for copies of this catalogue will receive attention.

A. L. Ide & Sons, Springfield, Ill., have issued a booklet describing the "Ideal Special" engine. The advantages of this engine are pointedly presented and the illustrations are all that can be desired. The booklet may be had free upon application to the above address.

The Joseph Dixon Crucible Company, Jersey City, N. J., is sending out a neat folder describing Dixon's silica-graphite paint for the protection of structural steel and tin roofs. This paint should prove a valuable help to the central-station man who has iron work to preserve.

M. B. Austin & Company, Chicago, Ill., manufacture the "New York" flush switch, which operates by a single button, the alternate pushes turning the lights off or on. This switch is approved by the National Board of Fire Underwriters, and is on sale by many leading supply houses.

The two large Warren alternators furnished by the Warren Electric Manufacturing Company, Sandusky, Ohio, for the new Armour electric station at the Union Stock Yards, Chicago, recently described in the ELECTRICAL REVIEW, were of interest to a number of electrical convention visitors, who inspected this plant.

The importers of the "Ship" carbons mention that the volume of this brand of carbons brought into America during the past season has been greater than during any preceding year. These carbons, as is perhaps well known, are imported by the manufacturers, Schiff, Jordan & Company, 232-234 Greenwich street, New York.

The Western Electric Company, Chicago, has closed a large contract for generators and motor equipment for the new shops of the Colorado & Southern Railroad, now being built at Denver, Colo. The contract for the electrical equipment in the Willard Hotel, Washington, D. C., has been awarded to the Western Electric Company.

The Sprague Electric Company, New York, has just published a beautiful illustrated pamphlet describing its new safety system of electric water type bulkhead doors for ships. This system may be operated from any part of the ship, is instantaneous in action in case of emergency, and has already proven itself of high value.

The Peru Electric Manufacturing Company, Peru, Ind., are introducing a new rosette, which has been especially designed for moulding work. The base being square permits the moulding to be readily fitted to the cutout. This rosette, known as the "Pemico," is but one of the many electrical porcelain specialties made by this company.

The Shelby Electric Company, of Shelby, Ohio, has been vicariously honored in the person of its president, Mr. W. W. Skiles, who has received the nomination for Representative in Congress, of the fourteenth district of Ohio. In this district a nomination is equivalent to an election. It is hard to keep electrical men back, even in politics.

The Falcon Electric Manufacturing Company, New York, says that the entire product of its shops for the next 60 days has practically been sold. This company has recently increased its manufacturing space a second time and is contemplating still further enlargements. It makes fan motors, switchboards and a variety of electrical specialties.

The Bossert Electric Construction Company, Utica, N. Y., is operating its plant to the full capacity for the production of steel outlet and junction boxes, switches, panel board and constructed switchboards. This company is represented as follows: R. B. Corey, New York; Smith & Crockett, Boston; L. Bancroft Mellor, Philadelphia; A. L. Bosley, Baltimore.

The Sprague Electric Company, of New York city, has issued bulletin No. 400, illustrating and describing the Greenfield flexible steel-armored conductors. This material is also made in the form of steel-armored flexible lamp cord which is meeting with great favor in places where the ordinary cord is frequently useless on account of the exacting conditions of service.

The direct reading ohmmeter, made by the American Electrical Specialty Company, 123 Liberty Street, New York, is now in general use by many electricians who have given testimony to its accuracy. It is designed so that an inexperienced man may find an unknown resistance in 12 seconds. This company have literature fully describing the construction and operation of the apparatus.

A New Stanley Factory. The board of directors of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., has authorized the company's management to spend $300,000 for a new factory at Pittsfield. A contract has already been let for a machine shop 500 feet by 90 feet. In addition there will be, besides an office

building, a new carpenter and pattern shop and a new power plant

Mr. J. E. Keelyn, Evanston, Ill., who is well known to the independent telephone fraternity, has issued a circular informing the public at large that he is prepared to supply exchange telephones, multiple telephones, bipolar receivers, and rocker-arm transmitters at reasonable prices. Mr. Keelyn makes some very strong claims for his apparatus and will be glad to quote prices on request.

The American Electric Heater Company, Detroit, Mich., have several catalogues most interesting to those who care to note the progress made in the construction of electric heating apparatus. This company, in addition to manufacturing regular lines of apparatus for electric cooking, heating and soldering, makes a feature of special apparatus used in hat, clothing and other industrial factories.

The Hunter Fan and Motor Company, Fulton, N. Y., are glad to furnish information and price to central-station managers and those interested relative to the Tuerk alternating ceiling fans, of which they are the manufacturers. This company is represented by the Western Electric Company in Chicago and the West, and by E. B. Latham & Company, New York, in the East and for all export trade.

The Interstate Electric Company, Cleveland, Ohio, has been bought by several men of means and new shops have been equipped for the making of "Cosmos" arc lamps. The company has several types already on the market and a number of others are now nearing completion. These lamps have been pronounced by practical electricians to embody several decided improvements in arc lamp construction.

The Erie City Iron Works, of Erie, Pa., has just issued from the press a tasteful catalogue entitled "Four Valve Engines." The cover is printed in colors and gold, and the illustrations are of a high order of merit. The catalogue describes the engines manufactured by this firm, and the detail illustrations are a great help to an easy understanding of the engines. The catalogue may be obtained free on application to the above address.

The Williams Electric Company, Cleveland, Ohio, has recently issued a small catalogue with complete illustrations and descriptions of the telephone apparatus manufactured in its shops. This apparatus includes several distinct types of exchange instruments, desk sets, inter-communicating sets, magneto bells, long-arm transmitters, microphones, receivers, switchboard generators, ringers and many other parts used in telephone construction.

The Montauk Multiphase Cable Company, 100 Broadway, New York city, reports that its fire detective cable recently proved its practical merit at a fire in Melbourne, Australia. The first intimation of a serious fire in a prominent building was given through the local fire alarm which was actuated automatically by the fusing of a Montauk cable on the top floor. It is believed that the spread of the fire was prevented by this prompt alarm.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, took advantage of the annual meeting of the American Society of Mechanical Engineers, at Cincinnati, last week, to issue for their benefit and others of its friends, a souvenir illustrating its handsome plant at Norwood, Ohio, and giving pictures of its numerous lines of manufacture. The souvenir is a creditable achievement and will doubtless be greatly appreciated by those who have been favored with it.

The Monarch Fire Appliance Company, 27 William street, New York city, has issued a convincing booklet describing the merits of the "Kilfyre" fire extinguisher for use in telephone exchanges, telegraph offices and electric lighting and power plants. "Kilfyre," as is well known, is a dry compound, and is especially adapted for use where water would do more damage than fire. The company has already equipped a large number of electrical plants and will be glad to send full particulars on request. The electrical department of the company is in charge of General C. Henry Barney, assistant general manager, who is well known to the electrical fraternity at large.

Mr. Frederick J. Down, of England, has severed his connection with Messrs. Laing, Wharton & Down, Limited, and has established a business in London for supplying electric railway and lighting apparatus and specialties. Mr. Down is well known, not only in his own country, but to many Americans, as having introduced the Thomson-Houston system into Europe, as well as the Okonite cable business. Mr. Down also obtained for his old firm agencies for the J. G. Brill Company, the Walker Company, and the Forest City Electric Company. Mr. Down begins business for himself with 17 years' experience behind him and will without doubt have the best wishes not only of his friends at home, but of many in the United States.

The great sale of "Cling Surface" for belts is an interesting illustration of what may be done by effective advertising. The sales of this preparation have reached really enormous proportions. It is used by large numbers of electric light and power stations where belts are in service, and its introduction has been accomplished almost wholly by generous and unique advertising within a period of two years' time. In a recent interview, the president of the Cling Surface Manufacturing Company, at Buffalo, N. Y., made the remark that when cling surface was first put on the market he knew that the compound had merit for adding to the value of belts used for transmitting power and that he had the same faith in the value of advertising for making it known; so cling surface, printer's ink and faith had won.

Eugene Munsell & Company, and the Mica Insulator Company of New York and Chicago, will have a joint exhibit at the Paris Exhibition. They were fortunate in securing a prominent position in the main floor of the Electrical Building, and their display will be in every way worthy of the largest mica dealers in the world, and the inventors of the most popular forms of mica insulators. Munsell & Company have sent samples of every grade of mica used by the electrical trade, including many unique and rare specimens which they have gathered during the fifty years the house has been engaged in the mica business. The Mica Insulator Company will show a full line of the micanite insulators and insulating materials, of which they are the originators and patentees, and also of the "Empire" insulating cloth and paper, which are manufactured by their special processes. Descriptive pamphlets printed in all the principal languages of Europe will be given to visitors who are interested in the exhibit.

The new establishment of the Michigan Electric Company, Detroit, Mich., has become the great electrical centre for the middle west between New York and Chicago. Complete stocks of all modern supplies for electric light, telephone and street railway equipments are always on hand, from which prompt shipments are made. In addition to the sale of electrical supplies the company has a department devoted to electrical engineering for the designing and complete construction of central stations and isolated plants for light and power. Particularly competent men are in charge of this department, and during the past few months several most interesting stations have been constructed in which batteries of chloride accumulators, for which this company are agents, have been placed. Also, a department is devoted to repairing electrical machinery, testing, rewinding and repairing, in which skilled electrical workmen are employed. The making of electric signs is another branch of this company's business, and electrically illumined signs of artistic and unique designs have been sent from its shops to many parts of the country.

The Western Electrical Supply Company, of St. Louis, has just distributed its general catalogue No. 22. This catalogue is probably the largest that has ever been issued in this trade, it being a handsome cloth bound book 7½ by 11 inches in size and 2½ inches thick. It contains 1,054 pages and innumerable illustrations, and weighs seven pounds. The catalogue is admirably arranged and well indexed, and contains what so many catalogues need, a page of errata. It covers practically all branches of electrical supplies, such as dynamos, transformers, railway and power motors, electric mining apparatus, fans, lamps, both arc and incandescent, projectors, sockets, receptacles, fuses, circuit breakers, complete switchboards, cutouts, binding posts, lamp sockets, commutators, tape, rheostats and regulators, conduits, etc., etc. The Western Electrical Supply Company is to be congratulated upon this admirable publication, which is practically a handbook of information concerning electrical machinery and apparatus of all kinds, from bug cutouts to 5,000-kilowatt generators.

CORPORATION NEWS

AUBURN, N. Y.—The Citizens' Light and Power Company, of Auburn, has been incorporated; capital $30,000. Directors: G. B. Leonard, F. T. Pierson, T. H. Mather and C. D. Beebe, of Syracuse.

CHICAGO, ILL.—The Zenith Electric Light Company has been formed; capital, $15,000; furnishing electric light and power. Incorporators: C. W. Buckley, Lewis J. Osborn, William G. Husband.

MOUND CITY, ILL.—The Mound City Water, Light, Power, Heat and Manufacturing Company, of Mound City, has been chartered; capital stock, $60,000; incorporators: A. J. Dougherty, G. J. Murphy and L. D. Stophlet.

WATERVILLE, ME.—The Federal Wire Company has been organized in Waterville with a capital stock of $150,000. The officers are: President, D. A. Proctor; clerk and treasurer, C. W. Davis. Wire cables and other electrical apparatus will be manufactured.

WEST ORANGE, N. J.—The Edison Manufacturing Company has been incorporated. Principal office, Lakeside Avenue, West Orange, N. J.; object, manufacture electrical apparatus; capital, $500,000. Incorporators: John E. Helm, Edward H. Duryee, Howard W. Hayes.

TRENTON, N. J.—The Welsbach Company was incorporated in the office of the Secretary of State recently, with a capital stock of $3,500,000. The company is to furnish light, heat and power. The incorporators are: F. H. Morris, of Philadelphia; John W. Develin, of Gloucester City, and E. Smalling, of Philadelphia.

LOS ANGELES, CAL.—The Excelsior Power Company has been incorporated with a capital stock of $150,000, divided into 1,500 shares, which amount has been fully subscribed. Los Angeles will be the company's principal place of business. The directors are: C. A. Hooper, George W. Hooper, D. C. Henry, San Francisco; R. P. Winters, Riverside; F. L. Morgan, F. B. Crosier and Sheldon Borden, Los Angeles.

TRENTON, N. J.—The American Electric Telephone Company has been incorporated in Trenton with an authorized capital of $3,000,000. The company is empowered to manufacture telephones and other electric appliances. Of the capital $1,000,000 is preferred with six per cent non-cumulative dividends. The incorporators are Barnett R. Ruggles, Henry M. Haveland, of New York, and James C. Young, Jersey City.

WINNEBAGO, WIS.—Articles of organization of the Winnebago Traction Company have been filed with the register of deeds. The capital stock is placed at $650,000, divided into 6,500 shares at $100 a share. The incorporators are: H. I. Weed, M. H. Eaton and G. W. Athearn. The Winnebago Traction Company is the same as the Citizens' Traction Company, only the name has been changed since the Emerson-McMillen Company absorbed the property some time ago.

GRAND RAPIDS, MICH.—A new suburban railway company has been formally incorporated under the name Grand Rapids, Spring Lake & Grand Haven Rapid Transit Company. The company is chartered for 30 years with a capital stock of $500,000, divided into 5,000 shares. The amount of stock paid in is $16,000, being about $500 per mile for the full length of the road. The stockholders are as follows: Justin R. Whitney, St. Clair, Mich.; George W. Carman, Marine City, Mich.; Seward L. Merriam, Detroit; Ithiel J. Cilley, Grand Rapids; Earl O. Cilley, Charles O. Smedley, Byron E. Parks.

JOHNSTOWN, N. Y.—The Fulton County Gas and Electric Company, with a capitalization of $1,500,000 to manufacture and supply gas and electricity for lighting the streets and public and private buildings of Gloversville and Johnstown, Fulton County, has filed articles of incorporation with the Secretary of State of New York. The directors are: George E. Spencer, of Brooklyn; John B. Summerfield, Armitage Mathews and Henry C. Everdell, of New York city, and James C. Young, of Jersey City. The company will also carry on operations in other towns of Fulton County. The capital stock is to consist of 15,000 shares at $100 each.

A NEW TELEPHONE RECEIVER.

OLYMPIA, WASH.—Articles of incorporation of the Seattle General Railway Company have been filed in the Secretary of State's office. J. M. Frink, George F. Meacham, E. P. Tremper and W. H. White are the incorporators, and the capital stock is $250,000, divided into 2,500 shares of $100 each. The objects of the new incorporation are set forth as follows: To acquire, construct, equip, own and operate street railways within the State of Washington, with the right to operate the same by steam power, electricity or cable traction; to sell light, heat and power; to engage in the steamboat business, etc. The principal place of business is to be Seattle.

NEWARK, N. Y.—The Newark-Marion Electric Railway Company has filed articles of incorporation in the office of the Secretary of State at Albany. The company has a capital stock of $100,000. The road is to be eight miles in length with terminals at the villages of Newark and Marion. The directors are: Ernest V. Pierson, Frank D. Burgess, William H. Nicholoy and William H. Kelley, of Newark; Caleb L. B. Tylee, William C. Snow and Clinton N. Tylee, of Penn Yan; Henry R. Sill, of Bluff Point, and C. H. Scutt, of Marion. Work on the road will be commenced at once. It will be constructed to accommodate both freight and passenger traffic.

A New Telephone Receiver.

The Eureka Electric Company, of Chicago, is placing upon the market a new high-grade telephone receiver. This piece of apparatus has been built with the most careful and minute regard for every detail. Its efficiency, according to the makers, shows that it is well balanced. The windings are in accordance with the powerful magnets used and the diaphragm is equalized with both. The binding-posts are of the lock-nut type. The makers state that their aim has been to produce as good a device as can be made and this they believe they have done.

An Electrical Planked Shad Dinner.

Mr. Charles E. Trump, president of the Novelty Electric Company, Philadelphia, annually provides a planked shad banquet for a few of his New York and Philadelphia friends. The event this year occurred at Washington Park, N. J., just below Philadelphia, a beautiful spot made attractive by the guiding hand of the Hon. William J. Thompson, the owner. The party consisted of Mr. Trump, and his brother, Mr. M. T. Trump, general superintendent of transportation of the Pennsylvania Railroad; Messrs. W. L. Candee and George T. Manson, of New York; Mr. George Steele, of Philadelphia, and one other lover of planked shad. The opportunity of seeing what is known as the "big net" hauled in by horse-power and some 1,500 beautiful shad loaded from it into a boat was greatly appreciated by the visitors, and added zest to the appetite with which they enjoyed the subsequent repast. Mr. Thompson presented the party with an interesting souvenir of the occasion in the shape of a small bottle of shad three days' old preserved in alcohol. The party found the shad as delicious as ever—in fact, the verdict was that they were never finer—and broke up at a late hour with many kind words of appreciation for their host. A pleasant evening was spent at the Hotel Flanders, in Philadelphia, where a number of electrical gentlemen attending the meeting of the American Institute of Electrical Engineers compared notes on planked shad dinners, one of which they had enjoyed the day previous.

Wall Street and the Electrical Stock Market.

The market during the week showed signs of weakness and lower prices resulted. The high-grade railway stocks suffered as well as industrials. Trading was marked by a feverish tone and the market at no time was attractive to the outside speculator.

On the New York Stock Exchange, General Electric closed the week at 134 bid and 136 asked, a loss of 2 points for the week. Metropolitan Street Railway, of New York, closed at 148½ bid and 148¾ asked, a loss of 6½ points for the week. Third Avenue Railroad, of New York, closed at 107 bid and 107½ asked, a loss of ½ point for the week. Brooklyn Rapid Transit closed at 68 bid and 68⅛ asked, a loss of 5⅝ points for the week. Manhattan Railway, of New York, closed at 88¼ bid and 88½ asked, a loss of 5⅜ points for the week.

On the Boston exchange, American Bell Telephone closed at no bid price and 305 asked, a loss of 11 points for the week. Erie Telephone closed at 103 bid and 105 asked, a gain of 2 points in the bid price for the week.

On the Philadelphia exchange, Electric Storage Battery common closed at 67 bid and no asked price. Union Traction closed at 36⅛ bid and 36⅜ asked, a loss of ¾ point for the week. Electric Company of America closed at 8⅜ bid and 8½ asked, a loss of ⅞ point for the week.

On the curb, or outside market, in New York, Electric Vehicle closed at 26 bid and 27 asked, a loss of 5 points for the week. Electric Boat closed at 16 bid and 20 asked, a loss of 5 points for the week.

Wall street, May 12.

While the week's dealings in the stock market showed little improvement in the conditions which have obtained for the past month, the majority of stocks held their own and closed the week in some instances at better prices than at the opening on Monday. While material gains were made in certain railroad and gas stocks, a number of industrials lost ground.

On the New York Stock Exchange, General Electric closed the week at 135 bid and 136 asked, a gain of 1 point in the bid price for the week. Metropolitan Street Railway, of New York, closed at 155 bid and 155¼ asked, a gain of 6½ points for the week. Third Avenue Railroad, of New York, closed at 108 bid and 109 asked, a gain of 1½ points for the week. Brooklyn Rapid Transit closed at 70⅞ bid and 71 asked, a gain of 2⅞ points for the week. Manhattan Railway, of New York, closed at 91⅛ bid and 91½ asked, a gain of three points for the week.

On the Boston exchange, American Bell Telephone closed at 312 bid and no asked price, a gain of 7 points for the week. Erie Telephone closed at 101 bid and 103 asked, a loss of 2 points for the week.

On the Philadelphia exchange, Electric Storage Battery, common, closed at 85 bid and 90 asked, a gain of 18 points in the bid price for the week. Union Traction closed at 38 bid and 38¼ asked, a gain of 2⅛ points for the week. Electric Company of America closed at 8⅞ bid and 9 asked, a gain of ½ point for the week.

On the curb or outside market in New York, Electric Vehicle closed at 26 bid and 30 asked, a gain of 3 points for the week. Electric Boat closed at 21 bid and 22½ asked, a gain of 2½ points for the week.

Wall street, May 19.

Electromobile Competition in Germany.

A competition instituted by the Mitteleuropäischen Motorwagen Verein between various types of electromobile cars has just been concluded in Berlin. The results are not yet to hand, but may be expected shortly, and judging from the names comprised among the jury—Gisbert Kapp and Dr. Kallman, among others—an impartial and instructive report on the trials may be anticipated, says the London *Electrical Engineer*. On the first day of the competition the weights, dimensions and other particulars of the competing cars were ascertained. Subsequently the batteries of the cars were discharged to the permissible minimum potential of about 1.83 volts per cell, and then recharged in order to determine their respective capacities. They were thereupon left in a charged condition until the following day in order to ascertain if any loss of charge had occurred during the rest. Numerous firms entered the competition, all sorts of vehicles being represented. On the second day, after due inspection of the cars, a trial run at an average speed of nine and one-half miles per hour was entered upon over a given course in order to ascertain the consumption of energy. After about three-quarters of the predetermined capacity of each car battery had been discharged, the return journey was made to the starting point, where the remaining charge in the batteries was discharged through resistances, the potential of the cells being observed during the operation. Hereupon followed a recharging of the batteries under precisely similar conditions to those observed on the first day.

James Blake Cahoon, President National Electric Light Association.

Lieutenant James B. Cahoon, U. S. N., retired, has been engaged in electrical work actively since 1889. He was graduated from the Naval Academy in 1879 and the United States Torpedo School, at Newport, in 1885, taking the post-graduate course in electricity. He formed a connection with the Thomson-Houston Company in 1889 as manager of the expert department, which he retained for some five years, and during this period was also engineer of the railway, marine and special production departments at the Lynn works, organizing those departments. He was then appointed engineer of the local companies' committee, having engineering charge of the local companies in which the General Electric Company held a controlling interest.

Mr. Cahoon left this work in May, 1895, to become general manager of the electric light, gas, water and street railway companies, of Elmira, N. Y., retaining the management of these until October 1, 1899. He was engaged during this period in rebuilding these properties, expending over half a million dollars in the work. He was selected as engineer to design and build a new 4,000 horse-power electric lighting plant, at Syracuse, and is now located in the latter city as a consulting engineer. Mr. Cahoon is also vice-president of the Oneida Light and Power Company, of Syracuse. He is a member of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers and a veteran companion of the Military Order of Foreign Wars, by reason of service during the Spanish-American War.

ITEMS OF INTEREST.

Mr. Edward Reynolds has been appointed auditor of the Postal Telegraph-Cable Company, vice Mr. George R. Williamson, resigned.

The Winnebago Traction Company, of Oshkosh, Wis., has elected the following directors: Emerson McMillin, F. H. Libbey, E. E. Downs, H. M. Clark, H. L. Battis, C. C. Chase, and George Athearn.

Mr. Stephen D. Field, the well known American electrical engineer who has been for some time engaged in electric railway work at Geneva, Switzerland, was a recent visitor to the Paris Exposition.

The Metropolitan Street Railway Company, of New York city, has just put in service a new electromobile repair wagon. The vehicle has two electric headlights and carries chemical fire extinguishers. The vehicle cost about $3,000.

ATTENDANTS AT THE NATIONAL ELECTRIC LIGHT ASSOCIATION'S CONVENTION.

C. F. Munder, Munder Electrical Works, Springfield, Mass.; Edwin R. Weeks, The Kansas City E'ec. Lt. Co., Kansas City, Mo.; Henry B. Cutter, Mrs. Henry B. Cutter, The Cutter Elec'l & Mfg. Co., Philadelphia, Pa.; Chas. F. Blizard, Electric Storage Battery Co, Philadelphia, Pa.; G L. Patterson, Stanley & Patterson, Inc., New York; G. W. Swan, F. W. Harrington, John A. Roebling's Sons Co., New York; J. M. Hill, Mrs. J. M. Hill, Mrs. S. D. Macdonald, Columbia & Elec. Vehicle Co., New York; E. H. Mullin, General Electric Co., New York; J. W. Ellard, the United Elec Lt. & P. Co., Baltimore, Md.; R. W. Rollins, Hartford Elec. Lt. Co., Hartford, Ct.; W. O. Turner, Boston, C. S. Knowles, New York; Stephen H. Goddard, ELECTRICAL REVIEW, New York; Wm. Lispenard Robb, Hartford Elec. Lt. Co, Hartford, Ct.; Chas W. Price, ELECTRICAL REVIEW, New York; Frank E. Colbert, ELECTRICAL REVIEW, Chicago; Edward L. Barr, Waclark Co., Chicago; Max Harris, Malcolm M. Baker, S. Marsh Young, Manhattan General Construction Co, Newark, N. J.; W. McLea Walbank, Mrs. W. McLea Walbank; Misses Walbank, Lachine Rapids Hydraulic & Land Co., Montreal; S T. Carnes, Memphis Light and Power Co., Memphis, Tenn.; H. B. Kirkland, American Circular Loom Co, New York; P. M. Fletcher, Western Electric Co., New York; T. J. Fleming, Buenos Ayres, South America; H. C. Roberts, H. C. Roberts Elec. Supply Co., Philadelphia, Pa.; J. J. Gorman, Manhattan Elec. Supply Co., New York, H. C. Adams, Jr., Phillips Insulated Wire Co., Pawtucket, R. I.; R. A. Fraser, Schenectady Ry. & Illg. Co., Schenectady, N. Y.; R. H. MacMillan, Des Moines Edison Lt. Co., Des Moines, Iowa; Frank McMaster, Fort Wayne Elec. Works, Chicago, Ill.; J. W. Hilgeman, Ft. Wayne Elec. Works, Ft. Wayne, Ind.; J. R. Wiley, Standard Underground Cable Co., Chicago, Ill.; E. L. Draffen, Beaver Dam Elec. Lt. Co., Beaver Dam, Wis; Thos. G. Grier, Wirt Electric Co., Chicago, Ill.; J. G. Pomeroy, Adams-Bagnall Elec. Co., Chicago, Ill.; E. J. Bagnall, Adams-Bagnall Elec. Co., Cleveland, Ohio; E. M. Jones, Bryan-Marsh Co., Chicago, Ill.; A. E. Carrier, Faraday Carbon Co., Jeanette, Pa., Cecil L. Saunders, J. W. Newcomer, United States Carbon Co., Cleveland, Ohio; E. Kuhlman, Kuhlman Electric Co., Elkhart, Ind.; Samuel Insull, Chicago Edison Co., Chicago, Ill.; A. B. Conover, John A. Roebling's Sons Co., Chicago, Ill.; F. Ellwood Smith, Somerville Elec. Lt. Co., West Somerville, Mass.; E. F. Phillips, the Peninsular Electric Light Co., Detroit, Mich.; H. D. Simpson, Baker & Co., Newark, N J.; W. D. Packard, New York & Ohio Co., Warren, Ohio; Joseph Sachs, H. W. Johns Mfg. Co, New York; Samuel C. D. Johns, Mrs. Josephine A. Johns, Miss Mabelle J. Johns, Mrs. Samuel Scovil, Cleveland Elec. Illg. Co., Cleveland, Ohio; Col. F. A. Copeland, Edison Light and Power Co, La Crosse, Wis.; W. Worth Bean, St. Joseph and Benton Harbor Elec. Ry. and Lt. Co., St. Joseph, Mich.; Mrs. G. M. Hoag, Cleveland, Ohio; C. H. Barney, Harry J. Doyle, Monarch Fire Appliance Co., New York; B. B Downs, Electric Appliance Co., Minneapolis, Minn.; P. F. Lyons, N. I. R. Co, Bristol, R. I.; H. H. Fairbanks, Worcester Electric Light Co., Worcester, Mass.; Geo. B. Neal, Charlestown Gas and Elec. Co., Charlestown, Mass.; Jno. W. Ferguson, Chicago, Ill.; Jas. P. McQuaide, National Conduit and Cable Co., New York; Henry A. Pierce, Pawtucket Electric Co., Pawtucket, R. I.; W. H. Slingluff, John A. Roebling's Sons Co., Chicago, Ill.; Wm. A. Fox, Chicago Edison Co., Chicago; Orin Smith, Jr., Pawtucket Electric Co., Pawtucket, R. I.; H. H. Holding, the Pelton Engineering Co., Cleveland, Ohio; Harold Almert, Lincoln Park Commissioners, Chicago, Ill.; E. F. Kirkpatrick, G. Electric Co, Chicago, Ill.; F. E. Donohoe, American Electrical Works, Chicago.; Louis A. Ferguson, Chicago Edison Co., Chicago; E. W. Rockafellow, Western Electric Co., New York; Edward R. Grier, Bryant Electric Co., Chicago; Robert Edwards, Jr., Edwards & Co., New York; F. P. Badt, Badt Goltz Engr. Co., Chicago; H. R Hixon, Simplex Electrical Co., Chicago; Henry Newgard, Chicago; Jas. E. Pyle, Edison Elec. Illg. Co., Westchester, Pa.; Ivan Frick Skinner, York Lt., Ht. and P. Co., York, Pa.; C. J. Bushnell, Chicago Edison Co., Chicago, Ill.; Geo. T. Manson, Okonite Co., New York; A. H. Patterson, Phœnix Glass Co., New York; J. Tyler Russell, Selma Gas and Electric Lt. Co., Selma, Ala.; Geo. D. Shepardson, University of Minn., Minneapolis, Minn.; Geo. Tailleur, J. Junkersfeld, H. B. Gear, Chicago Edison Co., Chicago; G. H. Atkin, Woods Motor Co., C. P. Matthews, Purdue University, Lafayette, Ind.; O. C. Pixley, John T. McRoy, Chicago; A. A. Piatt, Lansing, Mich.; Philip B. Woodworth, Lewis Institute, Chicago, Madison & Roby; E. D. Alexander, Commonwealth Elec. Co., Chicago; Chas. N. Munson, Fort Wayne Elec. Works, Chicago; G. W. Eastman, Chicago Edison Co., Chicago; Bion J. Arnold, Arnold Central Station Co., Chicago; Chas. E. Gregory, Chicago; J. Scribner, General Elec. Co., Chicago; Thos. B. Whitted, General Electric Co., Denver, Colo.; Charles D. Schlacks, Commonwealth Electric Co., Chicago, Ill.; A. D. Lundy, Sargent & Lundy, Chicago, Ill.; C. Fenton, Ohio; Mr. and Mrs. H. W. Hillman, General Electric Co., Schenectady, N. Y.; W. M. Deming, General Electric Co., Atlanta, Ga.; J. Arthur Jones, Sprague Elec. Co, Chicago; Louis Elliott, Sprague Elec. Co., Chicago; Frederic S Willcox, Sprague Elec. Co., Chicago; G. Marpole Willis, Jewell Elec. Inst. Co., Chicago; F. F. Leonard, Chicago Telephone Co., Chicago; Oliver P. Houge, Chicago Edison Co., Chicago; W. H. McClain, Chicago Edison Co., Chicago; E. J. Fowler, Chicago Edison Co., Chicago; H. T. Paiste, Philadelphia, Pa.; B. E. Sunny, General Elec. Co., Chicago; Geo. D. Rosenthal, St. Louis; E. Raymond, G. I. Co., Chicago; B. M. Downs Brookfield Glass Co., New York; John F. Gilchrist, Geo H. Jones. William Harris Pierce, Chicago Edison Co., Chicago; Thos. R. Mercein, Sec'y Northwestern Electrical Association. Milwaukee, Wis; L. P. Cody, Grand Rapids Elec. Co., Grand Rapids, Mich; J. H. Goehst, Chicago Edison Co., Chicago; Jos. E. Montague Commonwealth Elec. Co., Chicago; W. E Pimlott, J. M. Atkinson Co, Chicago; D. B Bullen General Electric Co, Boston; John T. McRoy, New York; J. M. Bradley, Consol. Elec. Light Co., Birmingham, Ala; A. M. Barron, Home Electric L. and P. Co., Elkhart, Ind.; Chas. B. Hunt, London Electric Co., London, Ont.; John A. Stewart, Rossiter, MacGovern & Co., Cincinnati, Ohio; E. J. Bechtel, Toledo Consol. Elec. Co., Toledo, Ohio; W. G. Nagel, W. G. Nagel & Co., Toledo, Ohio; Fred Bissell, The F. Bissell Co., Toledo, Ohio; Wm. J. Hartwig, C. J. Miller, American Electric Co., Detroit, Mich.; Frederic Nicholls, E. D. McCormack, Canadian Gen Elec. Co, Toronto, Can.; C. 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Co., Cincinnati, Ohio; D. P. Robinson, the Seattle Elec. Co., Seattle, Wash.; Frank G. Boiles, Bullock Elec. Mfg. Co., Cincinnati, Ohio; J. R. Lovejoy, General Elec. Co., Schenectady, N. Y.; R. J. M. Danby, Peninsular Elec. Lt., Ht. and P. Co., Grand Rapids, Mich.; P. F. Gottschalk, Crump's Elec. St. Ry., Lt. and P. Plant, Columbus, Ind.; B. S. Barnard, American Vitrified Conduit Co., New York; M. E. Turner, Cleveland Elec. Illg. Co., Cleveland, Ohio; Geo. M. Hoag, City Electrician, Cleveland, Ohio; Frank W. Frueauff, Denver Gas and Elec. Co., Denver, Colo.; Ira E. Price, People's Gas and Elec. Lt. Co., Canton, Ill.; Chas. E. Roehl, St. Jos. Ry., Elec. Lt. and P. Co., St. Joseph, Mich.; Burcham Harding, Westinghouse Elec. and Mfg. Co., Pittsburgh, Pa.; T. P. Gaylord, Westinghouse E. and M. Co., Chicago, Ill.; Geo. F. Sever, Columbia University, New York; Geo. C. Ewing, Morris Electric Co., New York; L. J. Osborne, Commercial Electric Co., Chicago, Ill.; C. C. Travis, Abingdon Elec. 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Jackson, University of Wisconsin, Madison, Wis.; Mrs. J. H. Livsey, Detroit, Mich; H. L. Drum, Edison Elec. Illg. Co., of Savannah, Savannah, Ga.; J. C. Kyle, Electric Light and Water Works, Ames, Iowa; M. H. Hussey, Wakegan Elec. Lt. Co., Waukegan, Ill.; Albert Scheible, George Cutter Co., Chicago; Otto M. Knoblock, the Miller-Knoblock Co., South Bend, Ind.; L. W. Greene, Brooklyn Elec. Lt. Co., Brooklyn, Ill.; H. W. Hillman, General Elec. Co., Schenectady, N. Y.; J. H. Cooke, Buckeye Elec. Co. Chicago; F. W. Page, Brainerd and P. Co., Brainerd; J. H. Pickette, M. B. Austen & Co., Lt. Frankfort, Ind.; R. J. Randolph, Maine Elec. and Ball Elec., Chicago; A. M. Hanbrich, Central Union Tel. Co., Chicago; William S. Aldrich, University of Illinois, Champaign, Ill.; R S. Feicht, Westinghouse Elec. and Mfg. Co., Pittsburgh, Ill.

EXHIBITION NOTES.

Mr. V. C. Grace, who has been long and favorably known with the Chicago General Fixture Company, has associated himself with Robert L. McOuat, of Indianapolis, Ind. The many friends of Mr. Grace will be glad to know he has identified himself with this well-known general electrical supply house.

Mr. John T. Burke, the well-known electrical supply dealer of Omaha, Neb., was at the convention. His company has just completed the installation of a modern and well-equipped electric lighting plant at Downer's Grove, Ill. The work includes generators made by the General Electric Company, Buckeye engine and Manhattan General Construction Company series arc lamps. The plant was started a few days ago and was acceptable to the town council in every detail, and not so much as a single arc lamp had to be altered or changed.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED MAY 15, 1900.

649,441 Sparking igniter for explosive-engines; C. E. Duryea, Peoria, Ill.

649,491 Electric storage battery; E. A. Sperry, Cleveland, Ohio—Comprising a group of cells containing material to become active, receptacles for the cells, a trough or vessel for holding the cells and water within the trough at a level below the top of the receptacles.

649,526 Safety synchronizing device; John Pearson, Minneapolis, Minn.—A rotary converter having direct-current leads and alternating-current leads and interdependent circuit-controllers for said leads, whereby the actuation of the one will cause the actuation of the other.

649,527 Cut-out; Elza Pettet, Farmer City, Ill.

649,544 Bracket for electric lamps; W. H. Morse, Billings, Mont.—A lamp-bracket comprising an arm, a clamping-collar slidably engaged with the arm, a socket-receiving band, and a common means for holding the band to the collar and for clamping the collar upon the arm.

649,549 Electric-light system; H. F. Roach, St. Louis, Mo.

649,551 Carbon for electric lights; J. F. Sanders, Portland, Ore.—A carbon for electric lights having a core in which a phosphoric salt forms one of the ingredients, a body composed of carbon material proper, and a coating composed of illuminating metal.

649,552 Brush-holder for electric machines; H. Sawyer, Muskegon, Mich.—A lever arranged to exert a pressure on the end of the carbon or brush, an additional lever arranged to exert a pressure on the side of the brush or carbon, and a spring arranged to exert its tension on both of said levers

649,554 Electric switch; Ferd. Schwedtmann, St. Louis, Mo.

649,572 Controlling and distributing electric energy; F. W. Erickson, Boston, Mass.

649,574 Spacing rib or block for armature cores; J. A. Foshag, Schenectady, N. Y.—A spacing or separating rib for attachment to one of the laminations of an armature core, consisting of a narrow band of plate metal with lugs projecting from one edge of the band, the band being

(Continued on page 52.)

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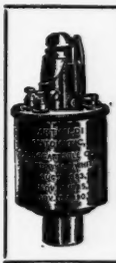

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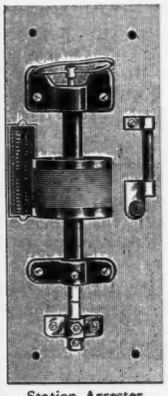

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PATENTS.

(Continued from page 49.)

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649,586 Closed-conduit electric railway; D. G. Stoughton, Hartford, Ct.

649,587 Electric clock; S. P. Thrasher, New Haven, Ct.

649,589 649,591 Secondary electric clock; S. P. Thrasher, New Haven, Ct.

649,614 Apparatus for electrolysis; A. E. Peyrusson, Limoges, France.

649,620 Electric brake; C. W. Steel, Toronto, Canada.

649,621 Apparatus for transmission of electrical energy; Nikola Tesla, New York, N. Y.—A transmitting coil or conductor connected to ground and to an elevated terminal, respectively, and means for producing therein electrical currents or oscillations, of a receiving coil or conductor similarly connected to ground and to an elevated terminal, at a distance from the transmitting coil and adapted to be excited by currents caused to be propagated from the same by conduction through the intervening natural medium, a secondary conductor in inductive relation to the receiving conductor and devices for utilizing the current in the circuit of said secondary conductor.

649,632 Automatic telephone toll apparatus; L. M. Ericsson, Stockholm, Sweden.

649,644 Controller mechanism; A. E. Norris, Cambridge, Mass.

649,653 649,654 Battery compound; Henry Blumenberg, Jr., New York, N. Y.

649,661 Electric signaling apparatus; F. K. Fassett, St. Louis, Mo.

649,699 System of motor control; C. W. Larson, Schenectady, N. Y.—A movable body, a device to be moved, constituting a support therefor, a

(Concluded on page 53.)

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(Concluded from page 50.)

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649,797 Means to be employed in electric traction; Marie J. Barreau, Paris, France.

649,840 Process of operating primary batteries and regenerating elements thereof; H. K. Hess, Philadelphia, Pa.

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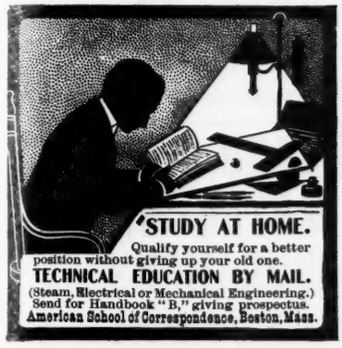
649,862 Cloth cutter; Robt. Phillips, Baltimore, Md.

649,868 Telephone-exchange system; W. D. Gharky, Philadelphia, Pa.

649,893 Printing-telegraph; J. Stockert, Kothen, Germany.



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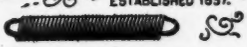

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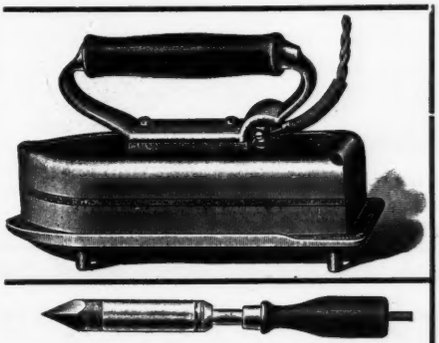

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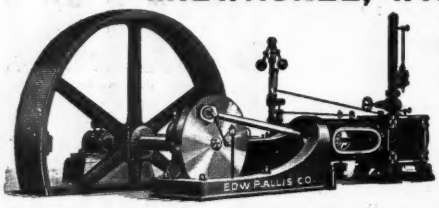

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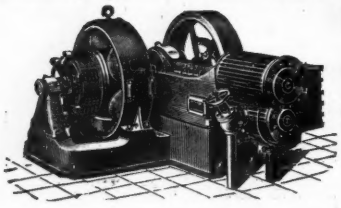

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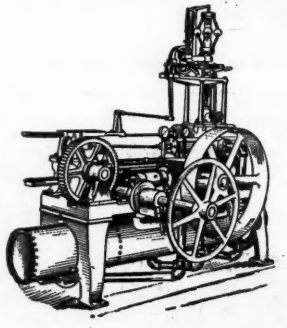

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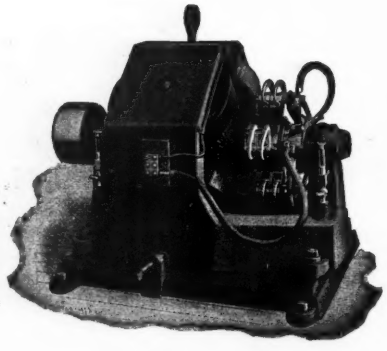

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